The HANDBOOK *of* CEMENT WATERPROOFING

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BUILDERS' EDITION

KERNER-GREENWOOD & CO. LTD.

THE HANDBOOK OF CEMENT WATERPROOFING

CONTAINING

SPECIFICATIONS AND DIRECTIONS FOR THE PREVENTION OR REMEDY OF ALL KINDS OF STRUCTURAL DAMPNESS AND FLOODING, BY THE USE OF PORTLAND CEMENT, AND

Registered **'PUDLO'** *Trade Mark*

BRAND

CEMENT WATERPROOFING POWDER

Registered in all Countries registering Trade Marks

SOLE PROPRIETORS & MANUFACTURERS

KERNER-GREENWOOD & CO. LTD.

Specialists in the Waterproof Construction
:: and Renovation of Buildings ::

KING'S LYNN :: ENGLAND

Telephone: 93 King's Lynn. *Telegrams: Greenwoods, King's Lynn.*

Codes: Bentley's, Marconi International, A.B.C. (5th Edition) & Premier

The descriptive name of the product referred to in this book is "'PUDLO' Brand Cement Waterproofing Powder." The word 'PUDLO' is the trade brand of KERNER-GREENWOOD & Co., Ltd., by whom all articles bearing that brand are manufactured or guaranteed.

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PREFACE

THIS handbook has been compiled for the purpose of facilitating the preparation of Specifications for varied types of waterproofing work. Regard has been given to obtain the greatest economy consistent with successful results.

Any expenditure upon labour and materials for waterproofing work that falls short of complete success, must nearly always be counted as a total loss. Ordinary prudence demands that the materials used shall be of undoubted excellence and entire suitability, and that the methods of their use shall be those which have, in similar circumstances, proved completely effectual.

For these reasons we decided, many years ago, that it was incumbent upon us as a duty, and also essential to our ultimate interests, to provide the users of 'PUDLO' Brand Waterproofer with a technical service, built upon a basis of careful experimental research, and the collation of carefully prepared data furnished by the results of a large number of practical operations. The experience of waterproofing with 'PUDLO' Brand Powder that we are now able to offer extends over a period approaching a quarter of a century in duration.

A collection of specifications comprehensive enough to include every possible application of waterproofed cement, would be both cumbersome and confusing. We have therefore limited the range of this book to those types of work that occur in everyday practice. Whenever circumstances arise that do not seem to be quite covered by these standard specifications, they will be considered with the same care, and a special specification supplied, without charge or obligation.

KERNER-GREENWOOD & CO., LTD

JANUARY, 1928.

INTRODUCTION.

WHY PORTLAND CEMENT MUST BE WATERPROOFED.

Portland cement has a high resistance to permeation by water when it is gauged with no more than the precise amount of water necessary for its complete hydration, provided that the whole of that water is taken up in the hydration of the cement, and none is lost by evaporation during its induration.

By patient manipulation, under the artificial conditions maintained in the laboratory, using only Portland cement and carefully selected and graded aggregates, it is possible to produce specimens of waterproof concrete. Experiments of this kind, whilst instructive as to the nature and properties of Portland cement, do not indicate the results that can be looked for under the less favourable conditions that are inseparable from practical operations.

In order to produce the plasticity—or "workability" as it is sometimes called—so necessary for the flow of concrete into the required forms, and for the easy rendering of cement mortar, it is essential to add more water than is necessary for the hydration of the cement. This surplus water forms minute cells or pores which, communicating with each other, become what are termed capillary canals, that are capable of conveying water throughout the mass.

It is obviously impossible to effectively waterproof concrete or mortar by the addition of any finely ground, inert material, or extra cement, in the endeavour to eliminate voids, because such additions still leave it necessary to add an excess of water in gauging the mixture, and so do not affect the predominant cause of porosity. The addition of an excess of cement should be avoided, not only on account of the expense, but because mixtures over-rich in cement are liable to develop surface cracks or crazings. These minute cracks are the visible evidence of the expansion and contraction of the cement matrix. The expansion and contraction are caused, both by changes of temperature, and by changes in the moisture content of the cement mortar or concrete. To put it more plainly, any specimen of cement mortar or concrete will expand when it is heated, or when it absorbs water, and will again contract when its temperature is lowered, or when the contained moisture is removed.

A very important fact, which has a great bearing upon the behaviour of Portland cement mixtures, is that the expansion and contraction consequent upon variations in moisture content, are on a far greater scale than the changes due to differences in temperature. It was established by exhaustive experiments, conducted by the U.S.A. Government Bureau of Standards, that when non-waterproofed concrete is thoroughly saturated, it expands as much as if its temperature had been raised 1,000 degrees Fahrenheit. It has also been shown as a result of experiments made by Prof. A. H. White, in the Department of Chemical Engineering at the University of Michigan, that the expansion of specimens of neat Portland cement that had been continuously immersed in water was measurably progressive, although at a decreasing rate, for fifteen years. The total expansion during this period was equal to 0.162 of the initial length, and half of this expansion occurred in the first two months.

The results of these investigations were summed up by Prof. White in the following words:— "*Alternate expansion and contraction due to changes in moisture is the greatest underlying cause of the destruction of concrete structures, for the strains due to volume changes produced by variations in the water content are usually far greater than those due to changes of temperature.*" It will be seen that if, by the waterproofing of the concrete or cement mortar, the absorption of water is prevented, expansion is limited to the relatively small amount consequent upon changes in temperature, and this is almost negligible.

The great freedom from hair cracks and crazings that is noted on specimens of cement mortar and concrete which have been waterproofed by the addition of 'PUDLO' Brand Powder, is explained very largely by this limitation of expansion due to the absorption of moisture, but it is also contributed to by the greater preponderance of sand or other aggregates that it is possible to successfully employ with waterproofed cement.

HOW CEMENT IS WATERPROOFED.

The essential structural differences between cement mixtures waterproofed with 'PUDLO' Brand Powder and cement mixtures without such addition, have been investigated by the well-known micrographer, Mr. James Scott. It is interesting to note that the data furnished by his microscopical examination confirmed the opinion formed by Dr. Johnson of Cork University that *the slightly greater strength of concrete when 'PUDLO' Brand waterproofer was included was due to the lubricating effect of the compound, which helped the particles of aggregate to arrange themselves more easily, thereby producing a denser and therefore stronger concrete.*

The chief effects resulting from the use of 'PUDLO' Brand waterproofer with cement mixtures may be briefly stated as follows:

1.—The chemical substances of which it is composed are balanced so as to react with the constituents of Portland cement. A new insoluble compound is thereby evolved which spreads and fills the most minute voids.

2.—The concrete or cement mortar treated with 'PUDLO' Brand Powder commences to acquire waterproof qualities immediately the initial set of the cement occurs. The outer surfaces thus becoming waterproof, prevent the escape of the contained water which, by evaporation from ordinary cement mixtures, leaves the mass honeycombed by capillary pores. This contained excess moisture is thereby sealed in the mass, and by remaining in contact with the granules of cement carries their hydration to a point where the contained water becomes chemically combined. This further hydration of the cement granules is accompanied by an increase in their bulk, so that the space previously occupied by the un-combined water is filled by the expansion of the hydrated cement, thereby eliminating the pores and densifying and strengthening the mass.

3.—Cement mixtures waterproofed in this manner are shown by micro-photographs to have the particles of sand and other aggregates more densely placed than they are in ordinary cement mixtures, and in addition, the cement matrix itself exhibits a remarkable density and freedom from cavities. The individual pieces of aggregate are lubricated into a closer arrangement, so that a lesser proportion of cement is required

to fill the voids in the aggregate. This effect of lubrication explains why the addition of 'PUDLO' Brand waterproofing powder enables cement mixtures to be gauged with less water, and yet be more easily manipulated. Such mixtures also attain a greater density than other mixtures that are richer in cement, but from which 'PUDLO' Brand waterproofer is excluded.

The history of the evolution of 'PUDLO' Brand cement waterproofing powder is a record of improvements. We are continually experimenting and as it is now manufactured, the powder is far superior to, and in some respects different from, what it was originally. The installation of new and specially designed machinery has also contributed to the manufacture of a cement waterproofing medium of the highest excellence.

THE WATERPROOFER.

'PUDLO' Brand waterproofer keeps indefinitely when stored under reasonably dry conditions. It is a white powder, ground exceedingly fine. Being light in weight, the powder when stored for long periods, may settle down in the containers and become more compact. The process of adding to, and mixing with the cement, will restore the waterproofing powder to its original finely divided condition. The powder will not cake unless it has actually been in contact with water.

Owing to the highly concentrated nature of 'PUDLO' Brand waterproofer, it is obvious that its waterproofing effect will be greater than that of an equal weight of any other waterproofing material to which water has been added in order to form a paste or liquid. The proportions of 'PUDLO' Brand waterproofer that are recommended in our standard specifications, are those that can be depended upon to produce a completely successful result under the conditions that these specifications are framed to meet. It has required courage and a great confidence in the merits of 'PUDLO' Brand waterproofer to stand out against the practice of recommending reduced proportions of waterproofing material, and cement, in order to show some price advantage in the finished work.

INEXPENSIVE.

Although the price of the Powder per lb., may seem high when compared with the cost of Portland cement, its use results in economy because the cement goes so much further. The greatest amount required is 5lbs. of the powder to 100lbs. of cement and then from 200lbs. to 500lbs. of aggregate are added to the cement. Thus 5lbs. of the powder waterproofs 300 to 400lbs. of mortar and 500 to 600lbs. of concrete. By no other method can a damp wall be permanently remedied for a few pence per square yard, over and above the cost of ordinary cementing. See the specifications given on page 26.

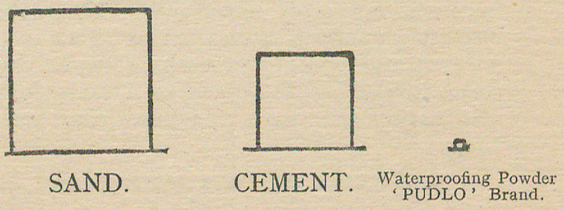
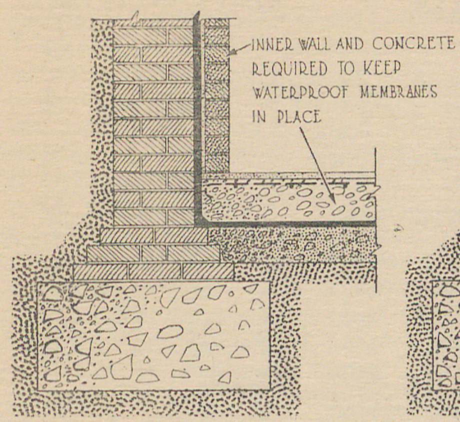


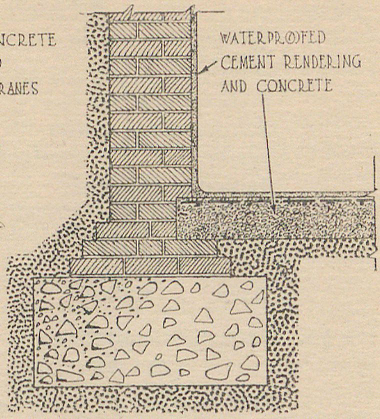
Diagram showing the proportionately small amount of the powder required for waterproofing Flat Roofs, Tanks, &c.

HOW TO WATERPROOF BASEMENTS



A

Expensive and bulky construction required with non-adhesive waterproofing layers.



B

Waterproofed Cement is part of the structure and adds to its strength.

THE INSIDE TREATMENT

The placing of waterproofed Cement renderings upon the inside surfaces of walls is a reversal of the method of using asphalte and other materials which have little or none of the adhesive power that cement mortar possesses.

FOR EXISTING Basements the interior treatment should always be adopted as this is the only certain method by which continuity of the wall and floor linings can be ensured.

FOR NEW WORK the advantages of the inside treatment are :—

(1) The whole of the work is always open to inspection and repair without incurring the heavy expense of excavation.

(2) The sun, wind, frost, and rain are all less severe to work which is in progress inside a building.

(3) There is a lesser superficial area of wall to be covered.

(4) The excavation is also less, for when the work is done outside, sufficient earth must be removed to enable the plasterer to work.

THE OUTSIDE TREATMENT

Nevertheless, for new work, building regulations sometimes require the waterproof rendering to be placed on the outside of the wall and in contact with the earth. It may also be found that the outside treatment is the more appropriate, and it has the advantage of keeping the walls themselves dry, and less subject to decay.

When flues and fireplaces are formed in the outside walls of new basements the external treatment is the safer method. Internal, *i.e.*, cross walls do not require treatment when the outside of the main walls are rendered.

The sketches on page 22 show the two methods which are usually adopted. We strongly advise the work to be done inside as shown on the upper sketch, whenever it is practicable.

TO FLOAT, RENDER OR PLASTER.

(In the proportion of 3 parts of Coarse, Washed Sand to 1 part of Cement). For severe conditions use 2 parts Sand to 1 of Cement.

Thickness of Waterproofed. Cement.	**WALLS.**	lbs. of Powder required to each 100 lbs. of Cement.	lbs. of Powder per super yd. of rendering.
$\frac{3}{4}$ inch	**Weather-beaten Walls**	3	$\frac{1}{2}$
	Rough Cast Walls		
	$\frac{3}{8}$" thick, i.e., in first coat only, if pebble-dashed	5	$\frac{1}{2}$
	$\frac{3}{4}$" thick, i.e., in both coats, if sand-dashed.	3	$\frac{1}{2}$
$\frac{3}{4}$ or 1 in.	**Defective Damp-courses** — **if $\frac{3}{4}$"**	5	$\frac{7}{8}$
	Render inside the room to cure — **if 1"**	3	$\frac{3}{4}$
1 in.	**Vertical Damp-courses** *To keep earth from damping a wall*	5	$1\frac{1}{8}$
	Basements, Stokeholes Reservoirs, Baths Sewers, Conduits Tanks, Manholes — 2 parts Sand 1 part Cement	5	$1\frac{1}{2}$
$\frac{3}{8}$ to $\frac{3}{4}$ in.	**Concrete External Facing** — **(if $\frac{3}{4}$" 2 lbs.)**		$\frac{1}{3}$
	(if $\frac{3}{8}$" 4 lbs.)		$\frac{1}{5}$

ON FLOORS AND ROOFS.

1 in.	**Floor Screeding (for Rising Dampness)**	2	$\frac{1}{2}$
	Railway Bridges (Sand **2**, Cement **1**)	5	$1\frac{1}{2}$
$1\frac{1}{2}$ in.	**FLOORS of Baths, Tanks, Reservoirs, Conduits and ROOFS—small.** — For this work we prefer :— 7 parts of $\frac{1}{4}$" granite chips, 3 „ coarse, washed sand, 4 „ of cement (This is $2\frac{1}{2}$ to 1)	5	2
	ROOFS—large, FLOORS of Basements, „ Stokeholes, „ Manholes — Use the Waterproofing Powder throughout the Concrete. Ask for a special specification and inform us of the span of roof and load to be carried, or the width of underground floor and the depth of flooding.		

OTHER PROPORTIONS.

	Parts of Sand.	Parts of Cement.	lbs. of Powder to each 100 lbs. of Cement.
Wells—To prevent pollution	2	1	5
Jointing Sanitary Pipes	3	1	2
(The use of sand is safer and more economical than the usual method of using neat cement.			
Preventing Efflorescence (Salting)	The aggregate we specify.		1
Concrete Blocks Infinitesimal quantity required.			
Artificial Stone See pages 29 & 37.			
Setting and Pointing Brick and Stone Work (This varies according to the mixture. Where practicable use a rendering instead of pointing).	3	1	4
	2	1	3
Setting and Pointing sides of Canal Locks	3	1	5
Damp-courses (Horizontal) $\frac{3}{4}$" thick. Ordinary conditions	3	1	3
„ „ „ „ Waterlogged or clay land	2	1	5

See Sheet of Special Instructions for a Waterproof Cement Wash.

CEMENT CONCRETE.

Aggregate to be as on opposite page. When the rendering is omitted add 1% of the waterproofing powder to the quantities here given.

For Ordinary Conditions, i.e., dampness only.
Mix concrete in proportions **3:2:1** with **2** per cent. of 'PUDLO' Brand Powder.
Render surface $\frac{1}{2}$-in. thick with **2:1 .. 5** .. ..

To Resist Water Pressure.
Mix concrete in proportions **3:1:1** with **3** per cent. of 'PUDLO' Brand Powder.
Render surface $\frac{3}{4}$-in. thick with **2:1 .. 5** .. ..

For Flat Roofs (large) use **3:2:1** with **2** per cent. of 'PUDLO' Brand Powder.
Render surface $\frac{3}{4}$-in. mixed **2 : 1** with **5** .. ..

For Flat Roofs (small) finish $1\frac{1}{2}$ins. thick with **7:3:4** with **5** per cent. of Waterproofing Powder, as given above. **Ask for a specification for all roofs.**

1.—THESE FIGURES ARE GIVEN AS A GUIDE. Much depends on the condition of the work. Heavy percolation naturally requires more Cement and more waterproofing powder than slight humidity. Describe the work and ask for a special specification.

2.—The proportion of waterproofing powder is calculated in relation to the weight of the Cement and not to the aggregate, thus :—3 to 1 with 2 lbs. of powder would be 300 parts of Sand to 100 parts of Cement, and 2 lbs. of waterproofing powder to every 100 lbs. of Cement.

3.—*There are 200 lbs. in an English Bag of Cement, 11 bags to the ton.*

GENERAL DIRECTIONS.

MATERIALS.

CEMENT mortar and concrete are waterproofed with the greatest economy, and with the utmost success, when 'PUDLO' Brand waterproofer is properly mixed with the Portland cement in the proportions required for the particular nature of the work. **If the best results are to be obtained with the least cost, the qualities, sizes and proportions of the sand, aggregate, cement and waterproofing powder must be arrived at in accordance with the following tables and directions.** Waterproofed cement concrete and mortar renderings are applied with complete success to all types of structural waterproofing. Their use effects a sure economy compared with any other waterproofing material or process that can be relied upon to give equal security. It will be understood, however, that the use of unsuitable sand or aggregates, an insufficiency of cement, or a neglect of the proper care that constitutes good workmanship, impose a handicap that the mere addition of 'PUDLO' Brand waterproofer cannot be expected to overcome. The following notes concerning the selection of materials for waterproofing work should be carefully read, and acted upon in the execution of any of the specifications given in these directions.

AGGREGATES. **Use non-porous aggregates** like clean, washed Pit Gravel, Shingle, River Ballast, Granite Chips (without white mica or felspar) Broken Flint, and Whinstone or other non-porous lime stone. If the Broken stone is dusty it should then be washed.

Do not use porous aggregates like Coke, Clinker, Brick, Sandstone or soft lime-stone. Crushed Slag is an unreliable aggregate because it may contain sulphur, or other materials detrimental to the cement. We would impress the fact that large, even sized, porous aggregates like broken bricks are totally unfit for waterproofed concrete work.

The aggregate must be small and well graded from ⅛" up to a maximum that is decided by the thickness of the concrete, in accordance with the following table.

A RULE FOR THE SIZE OF AGGREGATE.

For a	thickness of	1½"	use	¼"	(graded down to ⅛") aggregate.
"	"	2"	"	⅜"	" " " "
"	"	3"	"	½"	" " " "
"	"	4"	"	⅝"	" " " "
"	"	6 to 9"		¾"	" " " "

It pays the contractor to grade both the sand and the larger aggregates because the proportion of voids is thus reduced and the greatest density obtained with a minimum of cement.

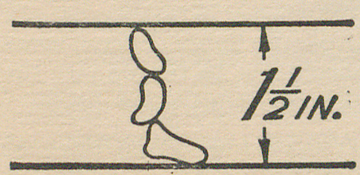


Fig. 1.

Suppose a roof covering were 1½" thick and concreted with ⅝" gravel and sand (mixed 2 gravel, 1 sand, 1 cement). In a sectional cut you would find, here and there, this arrangement.

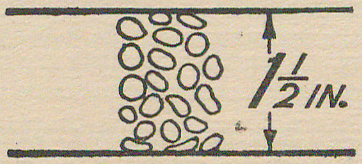


Fig. 2.

For roof coverings or other layers of waterproofed concrete as thin as this, we specify ¼" aggregate instead of ⅝" and this sketch shows the resultant section.

SAND. Must be washed clean and entirely free from earthy and clayey particles. Sand graded evenly from that which will pass a $\frac{1}{4}''$ mesh down to that retained upon a 40×40 mesh is the best for size. A $\frac{1}{8}''$ mesh sieve should not be used because it excludes the larger particles that should be kept in. **River sand** is preferable to pit sand. Sea sand should be avoided on account of the salt in it, but if no other is obtainable, it must be thoroughly washed in fresh water.

PORTLAND CEMENT. Should be fresh and comply in all respects with the British Standard Specification. It must be stored in bulk, in dry, airtight bins or sheds. Use only artificial cement, and avoid natural and slag cements. The finely ground and rapid hardening varieties of Portland cement are excellent for waterproofing work, especially in the treatment of flooded structures. White Portland cement is waterproofed equally well.

THE WATER. Must be clean and free from oil, dirt, alkali and other injurious chemicals.

METHOD OF MIXING.

TO MIX BY HAND. Place the required portion of cement in a heap. Add the specified amount of 'PUDLO' Brand waterproofing powder (*a box measuring $4\frac{1}{2}$ins. × $2\frac{3}{4}$ins. × 3ins. inside is included in all packages holding 28lbs. and upwards.*) *It holds 1 lb. of the powder when lightly filled. A box size 9ins. × 9ins. × 5ins. holds 10 lbs. of the powder. This, added to a 200 lbs. bag of cement, is equal to 5%.*

Turn the heap over with a shovel and riddle through a $\frac{1}{8}''$ mesh sieve to ensure a thorough mixture before the sand is added. This should be done out of the wind, to prevent both the cement and the waterproofing powder being blown away.

Now spread the mixture of cement and waterproofing powder over the sand (or if concrete is being made, over the aggregate we specify).

After mixing dry in the usual way, *add the water which must be gently sprinkled through a rose to prevent the powder being lifted out of the cement.*

Concrete must be turned three times dry and three times wet. Mix so that the concrete can be puddled into position. It should not "run" however, if thrown in a heap. A very wet mixture is liable to crack in drying out. The concrete must be lowered and not thrown into position.

TO MIX IN A MECHANICAL MIXER. Before adding the water, sand or aggregate, mix the dry cement and the waterproofing powder by six or seven turns of the machine. A little dry sand should first be thrown into the drum to take up any surplus moisture left from the last batch.

USE ALL CEMENT MIXTURES WITHIN HALF AN HOUR, that is before the setting commences. Afterwards the work must not be disturbed. Never revive the material by re-working it up, i.e., by breaking up the initial set. If unused concrete has once commenced to set it must be discarded for waterproofing work.

PREPARATION OF SURFACES.

WALLS. Remove any existing paint, whitewash or plaster. Punch the brick or stonework to form a key. This gives greater adhesion and is also much quicker than raking the joints. Use a ½″ mason's punch ; strike down from the top of the brick to flake off its surface. If old English bond, punch every other header and the middle of each stretcher. Brush with a stiff broom and wash down to remove all dust. Use plenty of clean water to satisfy the thirst of the dry bricks or stone, and so prevent the absorption of moisture from the cement mortar, which will occur if the walls are not well damped. If the wall is of concrete or has been previously cemented, hack the surface with a pointed hammer. This hacking must be done thoroughly so as to expose a fresh surface to not less than three-fourths of the total area. Then wash with clean water to remove the dust and loose particles, and slurry with a thick creamy wash of neat waterproofed cement. (See Directions for Bonding Grout or Slurry on page 12). Follow on with the first coat of the rendering before the slurry sets. When efflorescence (i.e., a growth of fine white crystals) has occurred upon the surface of a wall, and the wall is afterwards cement rendered, there is a possibility of the salts crystallising in the pores of the stone or brick just behind the rendering. The salts cannot pass through, nor appear upon the surface of a cement rendering that is waterproofed with 'PUDLO' Brand Powder, but the powerful disruptive forces that are set up in the process of crystallization may sometimes force off the surface of the wall itself, thus causing detachment of the rendering that has been applied to it.

For these reasons it is advisable, before rendering upon any wall that has shown signs of efflorescence, to drive 6″ cut nails into the bed joints, at frequent intervals, leaving their heads projecting about ⅜″ so that they are embedded in the thickness of the rendering, thus binding it to the wall. When possible, drive the nails with their flat sides vertical so that the tapering edges wedge themselves against the bricks. Cross joints are frequently hollow, therefore the bed joints are the most certain to offer a good grip to the nails.

FLOORS & ROOFS. Old concrete must be well chipped and the surface scrubbed with a hard brush (wire or strong fibre) to expose a clean surface and so form a key.

(*NOTE.—The careful application of a 10% solution, in water, of Hydrochloric Acid forms an excellent key. The acid eats away the cement surface but does not affect the particles of silica sand and aggregate which are, in consequence, left slightly protruding, thus offering a grip when the new concrete is placed in position.* ***It is of the utmost importance, however, that all traces of this acid should be removed by thoroughly washing with plenty of clean water, and that the final application of water should be made alkaline by the addition of a handful of common washing soda to each bucket of water, which will neutralise the remaining traces of acid.*** *If these precautions are not carefully adhered to, there is a danger of any remaining acid attacking the newly applied concrete, and thus destroying its bond to the old work*).

After washing the concrete face with clean water, from a hose if possible, to remove all loose particles and dust, leave the surface flooded with water to soak for at least 4 hours. Remove the surplus water and while the floor is wet, slush with a thick slurry of neat Portland cement to which 5% of 'PUDLO' Brand waterproofer has been added, and follow with the rendering or concrete, as the case may be, before the slurry dries. The slurry (grout) should be prepared as follows overleaf.

GROUT FOR BONDING. To be used in making work joints in new waterproofed cement renderings or concrete, and for bonding new waterproofed concrete or cement renderings to existing work.

Place the Portland cement in a heap. Add 5 lbs. of the waterproofing powder to every 100 lbs. of cement. Well mix, while dry, by turning them over with a shovel. Then riddle through a $\frac{1}{8}$ in. mesh sieve to ensure a thorough mixture. This should be done out of the wind to prevent both the cement and the powder blowing away. The water must be gently sprinkled through a rose to prevent the powder being lifted out of the cement. **Make the whole into a stiff mortar,** which has the effect of imprisoning the waterproofing powder. Thin this mortar by the addition of water until sufficiently liquid to flow evenly over the surface. Use a cement which has a slow initial set, so that the slurry does not set before the concrete or rendering can be applied. Do not mix more cement than can be used at once. This is most important.

It is not possible to indicate with any accuracy the covering capacity of a slurry. The amount of slurry required increases with the roughness of the surface it is applied to. When used as a wash on plain wall surfaces that are smooth, one lb. of 'PUDLO' Brand waterproofing powder, with 20 lbs. of cement, will be enough to give a single coat to approximately 30 square yards. Three coats are usually given to weatherproof a wall.

All washes that claim to cure dampness are temporary remedies. They are but thin films, which after being subjected to the scour of the weather for 4 or 5 years require renewal. For permanent results use a waterproofed cement rendering which is ultimately more economical. A rendering also adds to the strength of the wall while it excludes the heat in summer and gives comfort in winter by keeping the walls dry and the house warm.

METHODS OF APPLICATION.

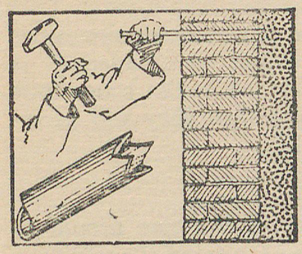
RENDERINGS ON WALLS. These should be thin and numerous, for instance, a 1″ rendering should be given in three coats, (each coat a bare $\frac{3}{8}$″ thick). If a greater thickness than $\frac{3}{8}$″ is applied in one coat to a vertical surface, there is a strong probability of the soft material creeping downwards, by gravitation, before the initial set of the cement takes place. This leads to bulgings from the wall and horizontal cracks, and although such defects may not be apparent to the casual glance, they would be likely to seriously affect the efficiency of the completed rendering.

Internal renderings to existing work should be extended to 24 ins. beyond the limits of any apparent dampness, because moisture is liable to travel both vertically and horizontally in the walls by capillary attraction.

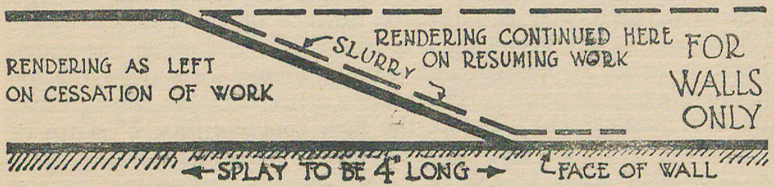
If the wall is sweating with damp, but not with running water, throw neat dry cement upon it. This will help to absorb the moisture.

When water trickles continuously from the inner face of an underground wall, it can generally be assumed that there is a collection of water in the subsoil around the structure. To deal effectively with such a condition it is necessary to line both the floor and the walls to form a complete inner tank of waterproofed cement work. The subsoil water must be prevented from exerting any pressure on the new work, by pumping from a sump. This sump collects the water by means of drainage trenches, all of which are fully described in the Section dealing with Basements in Flooded Ground, commencing on page 17.

It may happen that the rate of drainage to the sump is not sufficiently rapid to entirely relieve the walls of all pressure, in which case the drainage should be improved. Where a slight seepage of water continues to prevent the application of an interior rendering, and it is not convenient to drain it on the outside of the building by trenches taken to the sump, the water is drawn off by means of pipes which are driven through the whole thickness of the wall, in positions that will be decided by the location and the amount of the seepage. The pipes may conveniently be of ½″ diameter wrought iron, each having one end serrated so as to form a drill or "jumper." The pipe thus prepared, is used as a chisel. It gradually bores its way through the wall if it is given a slight twist between each blow of the hammer. Each pipe is long enough to stand out at least 1½″ from the inner face of the wall when the other end has completely pierced its thickness, thus providing an easy passage for the water, which will drip clear of the wall face. When the wall rendering has been completed and has set hard, the pipes are driven further, until the ends are below the face of the rendering. The open end of each pipe is then plugged with a bottle cork, and the rendering made good over it.


Inserting a weep pipe.

Rendering coats should be completed in one operation if possible, but if any one coat cannot be completed in the day, the unfinished edge should be left with a wide chamfer, say four or five inches on the splay. Upon resuming work, wash this with a neat waterproofed cement grout or slurry (as given on page 12) and render before the slurry dries.



Joints should not be made in the angles of walls, as is the usual custom with plasterers. The angles should first be roughly dubbed out, and then each rendering coat is carried continuously round, making the joint, if any, on the wall face as far as possible from the angle. Joints in succeeding coats should not occur in the same places. *See sketch on page 21.*

Follow on with each succeeding rendering coat before the other coat becomes dry, i.e., as soon as the undercoat has set sufficiently hard to hold it, otherwise the union of the coats will be weak. Also, owing to the non-absorbent qualities that waterproof cement acquires immediately it sets, there will be more labour in getting the following coat to hold.

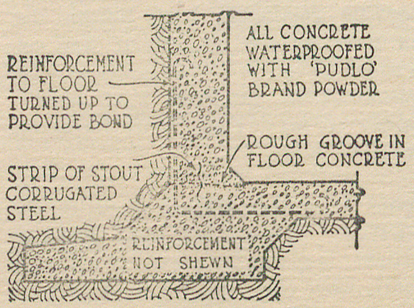
Scratch or rough each undercoat (but take care not to penetrate it) before applying the next rendering. A good key that obviates the danger of piercing the undercoat, is given by scraping off with the edge of the trowel, the smooth skin that its polished surface has formed. In doing this the mortar face is rucked or dragged up in the same way that the surface of a brick is left rough when the plastic clay is cut with a wire.

All internal angles, both horizontal and vertical, must be rounded to form coves. A very convenient implement for finishing the rounded angles is a smooth glass bottle about 3″ in diameter with a long neck by which it is grasped. The corner formed by the junction of a vertical and two horizontal coved angles may be brought to a smooth finish by the use of a float ball from the end of a cistern ball valve. The ball is simply pushed into the corner and given a few turns.

RENDERINGS ON FLOORS. Should be thick and always in one layer. When a rendering is placed upon new concrete, let it follow on while the concrete is "green," so that the two set together and then they will be inseparable.

CONCRETE. **The placing of waterproofed concrete should be carried on continuously** so as to avoid the weakness of work joints. If the concreting cannot be finished in the day, leave the edge as rough as possible, and upon resuming work, well water the edge and then brush it over with a thick creamy mixture of neat waterproofed cement, as given on page 12. Follow on with the new waterproofed concrete before the slurry dries. If the concrete is not reinforced, embed a strip of Expanded Metal or other reinforcement across the joint so that half of the strip will protrude and form a bond when it is covered by the abutting layer of concrete. Well tamp the new concrete round the reinforcement.

When the walls of a tank or a basement in flooded ground are of concrete, especial care is taken with the joints between the bottom of each wall and the top surface of the concrete floor. The surface of the floor concrete, where it occurs under the walls, is left as rough as possible, and a rough groove formed for the toe of the chamfer, or cove of the interior angle, between the wall and the floor (see sketch). Before the floor concrete sets, 6″ strips of stout sheet iron are forced edgeways into it, midway in the thickness of the wall, leaving half of their width protruding, to be in turn embedded in the wall concrete, thus forming a tongue or "baffle." The surface of the joint is thickly slurried, as previously described, immediately before the wall concrete is deposited. The ends of the strips are well lapped where they join, and also at the angles. 6″ strips cut lengthwise from sheets of corrugated iron are suitable for this purpose.



Typical section through Foundation of Reinforced Concrete Tank

Typical section through Foundation of Mass Concrete Wall

FINISHING TREATMENT.

RENDERINGS. When interior renderings to walls are left with a cement finish, a wood float is generally used. This gives a granular surface that does not induce condensation so much as a highly trowelled finish.

Never use a wood float for the finishing of tank linings. Tanks should have a dense, smooth finish, which is always the most water resistant. Flat roofs, and most floors also, are better with smooth, hard surfaces that can only be given with a steel trowel. When sufficiently smooth, the trowel should " ring " on the finished face of the work. Over-trowelling breaks up the initial set of the cement and causes hair cracks. Once-trowelling is the best.

Stucco (exterior rendering) is finished with a wood float, sometimes covered with sacking or otherwise treated, to give the textural effect desired. A trowelled finish to exterior cement work is hard and unpleasing in appearance.

CONCRETE. If concrete is to be left from the shuttering, and not rendered, the shuttering is made of planed boards (with the edges shot) to leave a smooth face. The waterproofed concrete is well tamped and spaded back from the face of the shuttering, to bring the finer stuff to the surface, and prevent the formation of cavities by the bridging of pieces of aggregate.

It will be found that owing to the greater workability conferred upon concrete by the admixture of 'PUDLO' Brand Powder, a much better result is attained with less effort than is required with ordinary un-waterproofed concrete.

If the surface of concrete that is to be rendered is too smooth when the shuttering is struck, it is hacked to provide a proper key.

KEEP ALL WORK DAMP. The finished surfaces of all waterproofed cement renderings and concrete must be kept damp for at least 7 days after completion. Good results are never obtained if any cement work is allowed to dry out prematurely. Horizontal surfaces are best dealt with by spreading wet sand or sawdust to a thickness of at least 1", and keeping this wet by soaking at least twice daily. Do not spread the sand etc., until the surface is sufficiently hard to receive it without pitting. Wall surfaces are sprinkled with water from a hose or kept damp by means of wet sacks or canvas hung upon them.

DECORATIVE TREATMENTS.

If no condensation is feared, the waterproofed cement may be followed with a coat of Keen's or Parian. A hard face is then produced which may be painted or papered. Whether decorated with paint or paper, the Keen's or Parian cement should be given a coat of " sharp " colour (i.e. with a preponderance of turps) as soon as it has set sufficiently to stand the brush. This prevents efflorescence and provides a key for the next application. Paint made with oil that is saponifiable (such as linseed oil) must not be applied directly to any cement surface, whether waterproofed or not, until the free alkali has become neutralized.

A trowelled surface of Keen's, Parian or other hard plasters will not absorb condensation. The report of H.M. Government Research Board on certain materials experimented with in reference to condensation on the surfaces of wall finishings, was very favourable to Sirapite. See also page 16.

REFIXING JOINERY.

LEAD PLUGS. Nothing should be allowed to pierce waterproofed cement work that is applied to keep back a pressure of water, but when joinery is refixed to the cemented face of a wall that has been treated for dampness, it should be screwed to lead plugs. Drill a neat hole through the waterproofed cement rendering and into the wall by means of a piece of ¼" diameter wrought iron pipe having its end filed as described on page 13. Cut a strip of 2 lbs. lead equal in width to the depth of the hole. Roll the lead up to form a cylinder that fits tightly into the hole. When the screw is driven into the cylinder of lead, the consequent expansion causes the lead to grip the sides of the hole. We have made satisfactory tests of Metlex Wallplugs. They are sold very cheaply by most ironmongers, in complete outfits comprising a supply of lead plugs, a drilling tool, screws and drive screws.

PREVENTION OF CONDENSATION.

To prevent condensation or sweating on interior walls, that are finished with cement, use a wood trowel (float). This gives a granular surface. It is, however, much better to skim over the cement with a 3 : 6 : 1 mixture of plasterer's setting stuff as given below. The following specification is recommended for extreme conditions :—

Rough render the walls, using cement and sand, with the addition of 'Pudlo' brand waterproofing powder and mixed to the specification recommended for the situation. Thoroughly scratch to form a key. Follow with the second coat as soon as the first coat is hard enough to hold it. Scratch as before, then, if no more than two coats of waterproofed cement are necessary, leave it to harden and give a coat of ordinary cow-haired plastering mortar ("coarse stuff," usually about 3 of sand to 1 of lime), to which a little Plaster of Paris is added at the time of using. (The Plaster of Paris hastens the setting and assists the adhesion). This coat is left scored from the wood nail float* in the usual manner to receive the final coat of plasterers' skimming. The final skimming coat given below should be applied when the lime mortar floating coat is hard enough to receive it. It may be faced either with the wood trowel (float), or the steel trowel, etc., to produce a granular, stippled or smooth surface, according to the finish desired.

THE BEST FINISHING COAT to prevent condensation is Plasterer's skimming or gauged "setting stuff" also known as "Limed Plaster." It is the usual mixture of lime putty, sand, and Plaster of Paris. The proportion depends on the quality or fatness of the lime, which varies in different districts, but after exhaustive experiments, we find the following mixture is the most absorptive of condensation. It gives a good finish, sets well, and works quickly :—

3 parts of lime putty run from Buxton or other pure Chalk Lime.

6 parts of washed sand.

1 part of Plaster of Paris. (This to be added at the time of using).

Oil Paint should not be applied to lime plastering (which unlike Keen's produces a soft face), until the alkali has become inert—it usually requires some months. If such walls must be decorated, use a reliable water paint or distemper which will form a good ground for a later application of oil colour. Painted surfaces are especially liable to condensation.

See also page 15, Decorative Treatments.

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* "Nail Float."—An ordinary plasterer's wood float through one end of which a small nail is driven so that the point projects about one-eighth of an inch above the face which comes into contact with the plaster.

SPECIFICATION FOR BASEMENTS.

When water surrounds any underground structure, the waterproofed cement work is subjected to a pressure that might burst up the floor—although it will not thrust off renderings that are upon the inner faces of porous brick or stone walls. In the case of a floor, the upward pressure depends upon the height to which the subsoil water rises above the underside of the waterproofed concrete, and such floors must be designed to resist this upward pressure. Where the head of water is small, the upward pressure is counterbalanced by the dead weight of the waterproofed concrete floor, in which case the reinforcement of the waterproofed concrete may be reduced and often entirely omitted.

When the head of water exceeds 12″ it becomes extravagant to employ a sufficient thickness of waterproofed concrete to counterbalance the upward pressure, indeed it often happens that such a substantial addition to the thickness of the floor would raise it to an inconvenient height. To avoid this, the floor is made thinner and reinforced with steel rods or a mesh type reinforcement. The reinforcement and the thickness of the waterproofed concrete, are calculated according to the head of water, and the span between the walls that pin down the edges of the floor slab.

In any case of doubt or difficulty, we are pleased to advise users of 'PUDLO' Brand Waterproofer, of the exact thickness of waterproofed concrete and the amount of reinforcement it is necessary to use in any particular set of circumstances, thus avoiding waste of material or sacrifice of security. This service is provided free of charge or obligation, and indeed, we prefer, in all cases where water pressures have to be dealt with, to provide fully detailed specifications to meet each individual case.

It is essential to protect waterproofed cement work from the pressure of water until the cement has attained strength to resist it. The most satisfactory method is to make proper provision for relieving the water pressure the *first* consideration, instead of leaving it to be hastily improvised during the progress of the work, when it becomes obvious that the pressure of water will otherwise destroy the value of the work already done, even if it does not imperil the success of the whole operation.

SUMPS FORMED OUTSIDE BUILDINGS. When the surroundings permit the formation of a sump on the outside of a basement or other structure in flooded ground, this is the most simple means of relieving the water pressure. The sump drains the water that would collect around the basement, and this water is pumped continuously from the sump during the progress of the cement waterproofing work, and for at least a week afterwards.

SUMPS FORMED INSIDE BUILDINGS. Difficulties of access, or obstruction by other buildings, sometimes make it impossible to form a sump on the outside of a basement and it is then necessary to form the sump in the floor of the basement that has to be waterproofed. The following procedure is adopted. In a convenient corner of the basement a hole is cut through the existing floor, and the ground beneath it is dug out to receive an old bucket or iron drum with perforated sides, which is surrounded with clean bricks or other hardcore, to permit free drainage. This drum is provided with a cover of sheet iron or rough board, perforated for the suction pipe, which reaches down to the bottom of the sump and is connected to the pump. Holes are bored in the side of the suction pipe, near the bottom, to prevent the obstruction which might otherwise occur through the collection of silt.

The method of assembling the suction pipe and sump bucket is shown in Fig. 1. A wrought iron plate is threaded on to the upper half of this pipe, and secured by back nuts, in such a position that the plate becomes embedded midway in the thickness of the waterproofed concrete, and so forms a perfectly watertight joint.

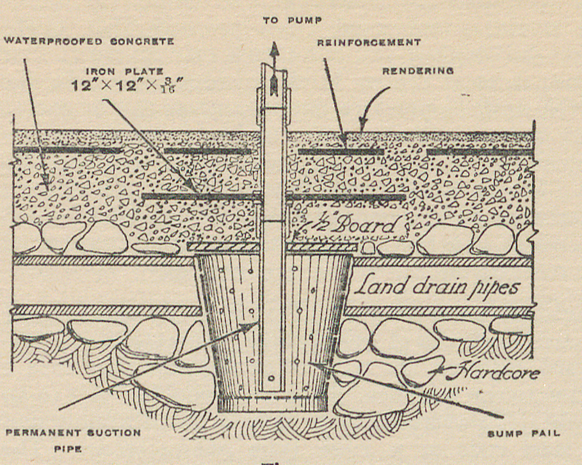


Fig. 1.
Section through Sump.

If the permanent suction pipe is allowed to project about 1" above the level of the finished floor, the cap may be unscrewed for inspection at any time. If pumping is required after completion of the work, this also is done without disturbing the floor. When circumstances do not permit of the pipe being allowed to project above the surface of the floor, the sump is sealed off below floor level with a screw cap as shown in Figs. 2 and 3.

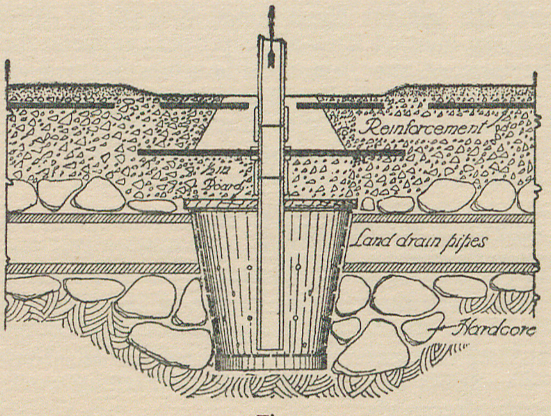


Fig. 2.

This arrangement is adopted when the fixed suction pipe must be kept below floor level. The Section shows the sump during pumping operations.

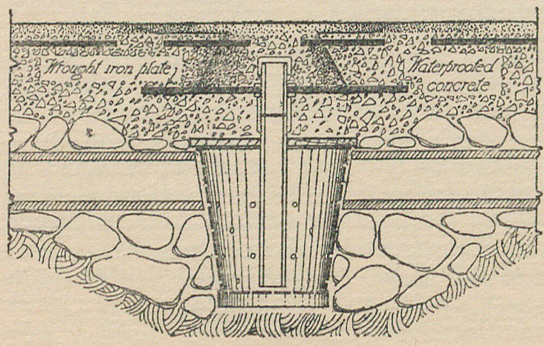


Fig. 3.

This Section shews how the fixed suction pipe is capped off and the floor sealed down after pumping has ceased. The method shown in Fig. 1. has obvious advantages of simplicity and low cost, and should be adopted whenever possible.

If the subsoil in which the basement lies is gravel, or earth, through which the water can freely percolate, the water will naturally drain from the surrounding ground into the sump, but if the basement is built in rock or in clay subsoil, the water must be drained from the excavation through holes in each of the outer walls, and then through drainage channels formed below the level of the new waterproofed concrete floor, which will conduct the water to the sump inside the building.

Sometimes the flow of water is so slow that no special means of sealing down the sump are necessary. In such cases the open sump is emptied, and what accumulated water cannot be baled out is absorbed with neat dry cement. Tamp the neat cement well down, and then fill the sump with concrete composed thus:—

3 parts non-porous aggregate riddled through a $\frac{3}{8}''$ mesh and graded down to $\frac{1}{8}''$.

1 part Washed Sand.

1 part Cement.

5 lbs. 'Pudlo' brand waterproofing powder to every 100 lbs. Cement.

CHASES IN EXISTING FLOORS. If the new waterproofed concrete is to be laid upon the surface of an existing floor, the drains are formed by cutting chases in the thickness of the old concrete, and filling the chases with loose, clean rubble, or better still, by laying agricultural drain pipes, with butted ends, in the chases, and surrounding them by rubble. These drains extend to the outer faces of the external walls, through holes cut in the walls.

TO PREPARE. **Remove all pipes,** wood and ironwork which otherwise would pierce or interrupt the continuity of the new cement work.

All Boilers and other apparatus must be removed and refixed after the cementing is done. Do not rest the furnace, boiler or heating apparatus on the new work, but place two or more courses of brickwork under it to distribute its weight, and to prevent the direct heat from injuring the surface.

Stone Steps give little suction and adhesion to cement renderings. Because of this, it is advisable to remove them, and to complete the waterproof lining to the floor and the surrounding walls. When the cement has set, refix the steps, taking care not to pierce the new work.

Steps of brickwork offer a good key and are prepared and rendered as described for walls. Arrises of all steps should be knocked off and each rendering coat carried continuously over the nosings. The many internal angles formed by the junctions of the treads with the risers, and junctions with the walls, should be coved out with care, as they are likely to be weak places.

The walls of the basement have their inner faces prepared as described on page 11 to receive the waterproofed cement renderings, and chases are cut to receive the edges of the new waterproofed concrete as shown in the illustration on page 22, but the walls are not rendered until the floor is laid.

The surface of an old concrete floor is well chipped and cleaned as described on page 11. All is now ready for the commencement of the waterproofed cement work. The pump is connected to the permanent suction pipe and pumping of the water is carried on continuously during the laying of the floor, and unless the upward

pressure is counterbalanced by flooding the floor as described below, this pumping must be continued without cessation until seven days after the whole work has been completed and is, therefore, strong enough to withstand the pressure.

The surface of the concrete floor is well brushed, and slushed with a thick slurry of neat cement, to which 5% of 'PUDLO' Brand cement waterproofing powder has been added, as described on page 12. Whilst this slurry is still wet, the waterproofed cement concrete *is laid over the whole area of the floor in one operation, without any work joints.* The concrete is laid to the thickness and with the reinforcement necessary to meet the particular conditions. (We suggest our free advice should be obtained). The edges of the concrete and the reinforcement are tucked into the chases cut in the walls to receive them, and the concrete is composed and rendered upon its surface in accordance with the Specification given on page 22.

NOTE.—The mesh type reinforcements such as Expanded Metal and B.R.C. Fabric are excellently adapted to work of this nature, but if it is preferred to use ordinary round steel rods as reinforcement, these should be laid in both directions to form a mesh, and the rods wired together, where they cross, to prevent displacement.

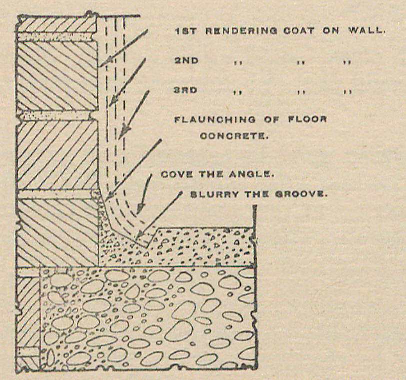


Fig. 4.
Section shewing Junction of Floor and Wall Renderings.

The edges of the floor rendering are flaunched slightly up the walls, and just before this rendering finally sets, a groove is cut 2″ distant from and parallel with each of the walls as shown in Fig. 4. This groove receives the edges of the rendering coats to the walls, and is thickly slurried with waterproofed cement before each rendering coat is worked into it. The face of the finished floor is trowelled to a smooth surface with a plasterer's steel trowel.

When the floor surface has been finished for 24 hours and has set firm, it may be flooded with clean water level with the top of the permanent suction pipe. The pump is then disconnected until it is required to resume operations.

Any rise in the level of the subsoil water around the structure will now cause an equal rise of the water inside, and the weight of this water upon the concrete floor, will counterbalance the upward pressure and prevent damage to the newly finished concrete. If the work can be left covered by water for a further 24 hours, it will harden sufficiently to resist damage by the workmen, who may then stand upon it to render the walls, provided that boards are put down for them to walk upon.

Before the rendering of the walls is commenced, the level of the water around the structure is lowered by pumping from the sump, and all water is removed from the surface of the floor. Soak up with cloths and dry cement any superfluous water that has collected at the bases of the walls and which might interfere with the application of the wall renderings.

The surfaces of the walls that have been hacked as described on page 11 are well damped to receive the first coat of the rendering.

Do not make the joints of the rendering in the vertical angles (the usual practice of plasterers), but first dub out the angles slightly as shown in Fig. 5. Each rendering coat is then carried continuously round the angle, the joint—if any—being made upon the wall face at some distance from the angle. The joints in the next coat are made upon the wall on the other side of the angle, and the joints in the third or any succeeding coats, are made as far distant as possible from any other joints. All joints are made with splayed edges and a thick slurry of neat waterproofed cement is applied immediately before the new work is joined on to that previously finished. See sketch on page 13. All internal angles, both horizontal and vertical are rounded to form coves as described on page 14.

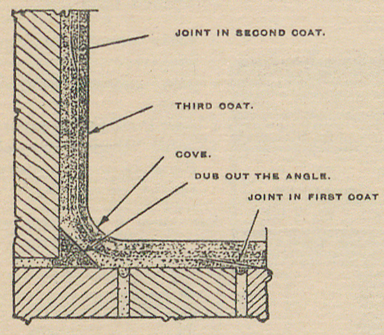


Fig. 5.
Plan at angle of a basement showing method of jointing the rendering coats on walls.

The composition and application of the wall renderings will be in accordance with the Specification 2B on page 22 and the directions given on page 12. **It should be noted that waterproofed cement renderings adhere with such tenacity to properly prepared wall surfaces that they resist any pressures of water that are likely to be imposed under practical conditions. There is no need to provide expensive inner wall linings of brick such as are necessary when waterproofing layers having no great adhesive properties are employed.** See illustrations on page 7.

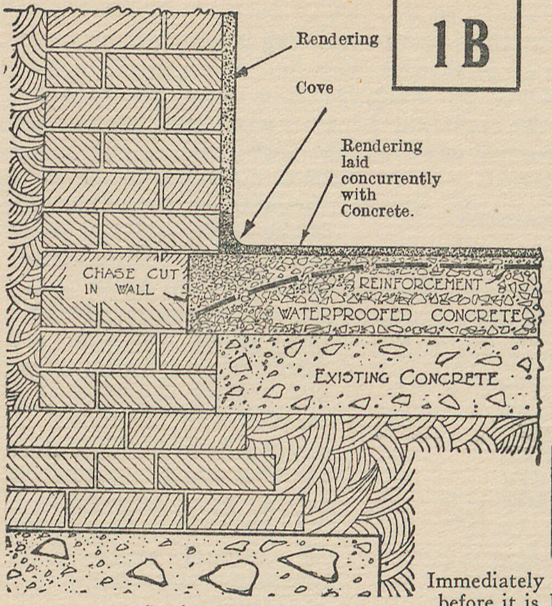
The importance of pumping continuously from the time the rendering of the walls is commenced, cannot be too greatly stressed. *This pumping must be maintained during the whole progress of the work and for at least a week afterwards,* because if the water is allowed to rise above the level of the new concrete floor, even momentarily, it may wash off the newly applied wall rendering, or at any rate cause serious defects. In some cases a basement may not be required for immediate use, and the prolonged pumping after the work is completed may be dispensed with if the interior is flooded, after the removal of the pump, thus permitting the water inside the basement to rise to any level that the water on the outside may reach. This flooding must not be effected until the interior wall renderings are hard enough to prevent their being damaged by contact with the water.

Specifications for Basements,

Stokeholes, Garage Pits, Manholes, and similar underground structures.

FOR WORK SUBJECTED TO WATER PRESSURE, *i.e.*, **in waterlogged ground, or where there is a varying flow of water.**

SPECIFN 1B



Section "A."
FOR BOTH OLD AND NEW WORK.

FLOOR.—Lay concrete to a thickness which we will give on receipt of the size of the floor and the greatest possible depth of flooding.

The concrete to be composed thus :—

3 parts non-porous aggregate.
1 part coarse, washed sand.
1 part Portland Cement.
3lbs. of 'Pudlo' Brand Powder to every 100lbs. of cement.

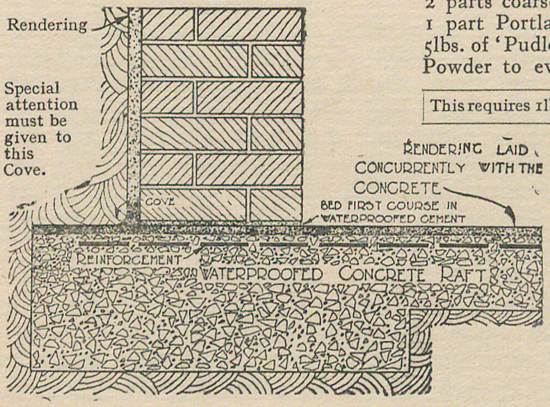
See page 9 for size of aggregate.

> This requires 1⅞lbs. of the powder per sup. yd. for each 3in. in thickness.
>
> 2½lbs. per sup. yd. for each 4in. in thickness.

Immediately the concrete sets and before it is hard, render ¾-in. thick within half an hour from time of mixing with :—

2 parts coarse, washed sand.
1 part Portland Cement.
5lbs. of 'Pudlo' Brand Waterproofing Powder to every 100lbs. of cement.

> This requires 1lb. of the powder per sup. yd.



Section "B." This sketch applies to NEW WORK ONLY.

There is always the danger of water pressure bursting the work when there is a rise and fall of water, therefore reinforce the floor concrete with steel rods or expanded metal—this also saves concrete. To ensure the most economical specification ask for the free advice of our Engineer.

SPECIFN 2B

WALLS.—Render 1in. thick (in 3 coats) with :—

2 parts coarse, washed sand.
1 part Portland cement.
5lbs. of 'Pudlo' Brand Waterproofing Powder to every 100lbs. cement.
This requires 1½lbs. of the powder per sup. yd.

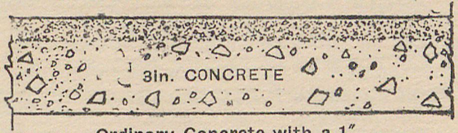
Where practicable the rendering should be carried 12ins. or 18ins. above the ground level.

FOR UNDERGROUND TANKS, BATHS, RESERVOIRS, and other receptacles which contain water, adopt the same concrete and rendering as Specifications above—See sketches on page 14. Special calculations are usually necessary for the reinforcement of tanks—ask for a specification.—See notes on page 25 for tanks above ground.

Specifications for Floors.

FLOORS for Kitchens, Sculleries, and to receive Wood Blocks or Jointless Composition.

FLOOR TYPE "A"



Ordinary Concrete with a 1" Waterproofed Cement Topping.

As soon as the 3" of ordinary, non-waterproofed concrete has been spread and levelled, and *before it finally sets,* lay upon it a waterproofed cement topping 1" *thick* in one coat and composed as follows :—

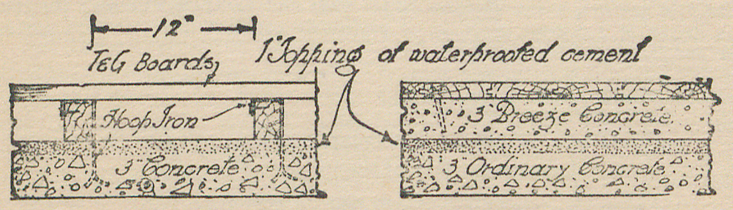
3 parts coarse, washed sand. **1** part Portland cement. **2**lbs. 'Pudlo' Brand waterproofing powder to every 100 lbs. of cement. (*½-lb. per yard super*).

This is a perfectly damp-proof and rot-proof foundation for wood block floors and to receive rubber tiling, "cork carpet" and linoleum.

Boarded Floors fixed over the Type "A" floor shown above.

FLOOR TYPE "H"

FLOOR TYPE "B"

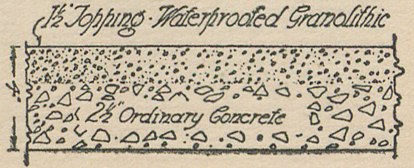


The strips of hoop iron have their ends split and turned, and are embedded in the concrete before it sets. When the **2**"×**2**" wood fillets are placed in position, the hoop iron strips are pulled over and nailed to their sides.
For floors of *small* area, the hoop iron anchor strips are not needed because when the floor boards are nailed to the fillets, the whole becomes rigid and is held down by the skirting affixed to the walls.
Insert ventilators as to a joisted floor.

For the **3** inches of breeze concrete use this mixture :—
6 parts clean breeze to pass a ¾" mesh sieve.
1 part Portland cement.
This will give the best concrete for nailing into. See that the breeze concrete is bone dry before nailing the boards on to it.
These two types of boarded floors are suited for the best rooms on ground floors. They are impervious to rising dampness, and they are also warm. Type "B" is practically noiseless.

FLOOR TYPE "C"

For floors to withstand hard wear.

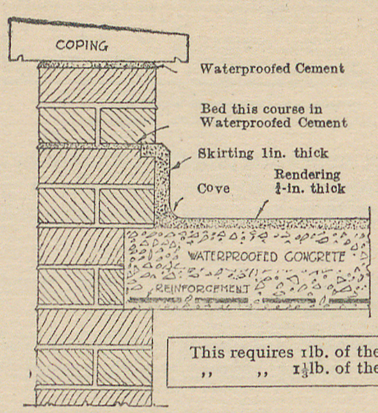


This floor is formed in a similar manner to Type "A" except that the topping is 1½" thick and is composed of *equal parts* of very coarse, washed sand (or preferably ¼" granite chippings) and cement. Add 2% of 'PUDLO' Brand Waterproofing Powder to the cement. (1⅜-*lb. per yard super.*) To finish, use a steel trowel and sprinkle with 'FERROUS' floor hardener ('PUDLO' Brand.)

Specifications for Flat Roofs

FLAT ROOFS (any size) when the entire Concrete is waterproofed.

SPECIFN 3A



Lay concrete to a thickness which we will give on receipt of the width between supports and the load required to be carried. The concrete to be composed thus :—

3 parts non-porous aggregate.

2 parts coarse, washed sand.

1 part Portland Cement.

2lbs. of 'Pudlo' Brand Waterproofing Powder to every 100 lbs. of cement.

This requires 1lb. of the powder per yd. sup. for each 3in. in thickness										
,,	,,	1¼lb. of the powder	,,	,,	,,	,,	,,	4in.	,,	,,

Immediately the concrete sets and before it is hard, render ¾-in. thick, within half an hour from the time of mixing the rendering material, thus :—

2 parts coarse, washed sand.

1 part Portland Cement.

5lbs. of 'Pudlo' Brand Waterproofing Powder to each 100lbs. of cement.

This requires 1lb. of the Powder per yd. sup.

Render in 3 coats, a 1in. skirting on all walls and parapets adjoining the roof, to a height of 2 courses of bricks or preferably continue it to the wall coping. Also bed the coping with :—

2 parts coarse, washed sand.

1 part Portland Cement.

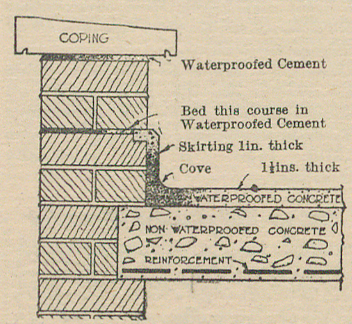
5lbs. 'Pudlo' Brand Waterproofing Powder to every 100lbs. of cement.

This requires 1½lbs. of the Powder per yd. sup.

See directions on pages 9 and 25.

FLAT ROOFS (small) when the Rendering only is waterproofed, and when the area does not exceed 15 ft. × 15 ft.

SPECIFN 3C



See directions on pages 9 and 25.

Prepare and slurry the surface of the non-waterproofed concrete as described on page 11. Lay or render concrete 1½in. thick in 1 coat, thus :—

7 parts non-porous aggregate to pass a ¼-in. mesh, preferably washed granite.

3 parts coarse, washed sand.

4 parts Portland Cement. (*This is 2½ to 1.*)

5 lbs. of 'Pudlo' Brand Waterproofing Powder to every 100 lbs. of Cement. This requires 2lbs. of the Powder per yd. sup.

Form the skirting and bed the coping as in specification 3A above.

The above proportions and thickness are also suitable for the lining of floors to tanks and other receptacles.—See Page 25.

For Old Roofs ask for a special specification.

ROOFS—Additional Notes.

In addition to the directions on page 11—

Give the roof a fall of 2 inches in 10 feet.

When the roof exceeds 15ft. × 15ft., waterproof the whole thickness of the concrete, but ask for a special specification.

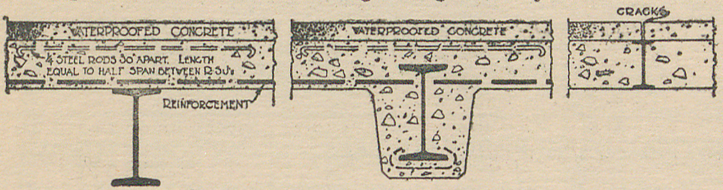
To obviate cracks. (1) It is well known that steel reinforcement **in small members** expands and contracts equally with the concrete, when it is evenly distributed. The expansion of **mass steel** such as in rolled joists, will produce cracks unless small, well distributed, steel reinforcement is placed over and at right angles to the joists.

(2) Also additional steel reinforcement should be placed over any intermediate supports and this must be specially calculated, otherwise there may be sagging (deflection) of the slab between the supports.

In both of the above cases, the extra reinforcement is placed 1in. from the top of the concrete and is equal in length to half the distance between the supports, *i.e.*, half the span.

The top reinforcement may consist either of suitable expanded metal or steel rods.

NOTE :—Whenever the main reinforcement is in one direction place a $\frac{1}{4}$-in. round steel rod at right angles every 30 inches.



TYPE 'A' TYPE 'B' TYPE 'C'

Of the above three types, " A " is by far the best as the reinforcement is continuous, and also because the joist is not embedded in the concrete. In Type " B " the concrete and reinforcement must be sufficiently strong to withstand the stress caused by the expansion of the embedded steel joist. Type " C " is a construction which should be avoided as the slab is completely severed by the R.S. Joist and cracks are therefore bound to occur.

Skirtings to Parapets and Walls. After punching the face of the wall to form a key, wash away all dust. Then form a skirting 6in. high (or if behind a parapet, as high as the coping), making it to the specification given on p. 24.

In tropical countries, it is advisable to cover the roof with gravel, coke breeze, small shells, or other loose material laid over straw, reeds, etc., to counteract the action of the sun on the surface of the cement. Owing to the temperate climate, it has not been necessary to adopt this precaution upon the numerous waterproofed cement roofs in the British Isles.

TANKS.

When a tank is above ground level or is in ground that is not subject to flooding by subsoil water, the waterproofing may be limited to a thin interior lining. The floor lining should be laid to a thickness of $1\frac{1}{2}''$ and composed in accordance with the 3C Specification, printed on page 24 and there recommended for Flat Roofs.

The rendering to the walls will be done exactly as described in the 2B Specification recommended on page 22 for the treatment of a flooded cellar. See figs. 4 and 5 on pages 20 and 21 for finish of angles. When a tank is surrounded by subsoil water, it is dealt with as if it were a flooded cellar, because in the event of the tank being emptied for cleansing or other purposes the pressure of the subsoil water would burst up a thin interior floor lining. See page 14.

Specifications for Walls.

PLAIN STUCCO OR FOR SAND DASH, that is, Rough Cast free from Pebbles, etc.

SPECIFN 1

Render ¾-in. thick (in 2 coats) :—

3 parts coarse, washed sand.
1 part Portland Cement.
3 lbs. of 'Pudlo' Brand waterproofing powder to every 100lbs. of cement. (*½-lb. per sup. yd.*)

(*For exposed situations use 2 of sand to 1 of cement and 5 lbs. of Powder. 1-lb. per sup. yd.*)

STONE AND PEBBLE DASH OR FOR ROUGH CAST MIXED WITH PEBBLES, etc.

SPECIFN 2

Render ¾-in. thick (in 2 coats) the first coat only to be waterproofed and to be ⅜-in. thick :—

3 parts coarse, washed sand.
1 part Portland Cement.
5 lbs. of 'Pudlo' Brand waterproofing powder to every 100 lbs. of cement. (*½-lb. per yd. sup.*)

(*For exposed situations use 2 of sand to 1 of cement and 5 lbs. of Powder.*)

The first coat only is waterproofed (with 5% instead of 3%) because the pebbles in the last coat may become loose and form ducts for rain but 2% in the last coat will give a cleaner face. The first coat must not be too deeply scratched when forming the key.

VERTICAL DAMP-PROOF COURSES. (To keep earth from damping a wall.)

SPECIFN 3

Render 1 in. thick (in 3 coats) upon the exterior of the wall :—

3 parts coarse, washed sand.
1 part Portland Cement.
5 lbs. of 'Pudlo' Brand waterproofing powder to every 100lbs. of cement. (*1½-lb. per yd. sup.*)

EXTERIOR TREATMENT.
For waterlogged or clay land.
Also
INTERIOR TREATMENT.
When the earth cannot be removed.

Render 1in. thick (in 3 coats).
2 parts of coarse, washed sand.
1 part of Portland cement.
5lbs. of 'Pudlo' Brand waterproofing powder to every 100 lbs. cement.
(*1½-lb. per yard super*)

To prevent condensation—see notes on page 16.

DEFECTIVE DAMP-PROOF COURSES.

SPECIFN 4

(*This saves the great expense of inserting a horizontal damp-proof course* :—

Render the walls *inside* the structure, 1 in. thick (in 3 coats) :—

3 parts coarse, washed sand.
1 part Portland Cement.
3 lbs. of 'Pudlo' Brand waterproofing powder to every 100 lbs. of cement.
(*¾-lb. per yard super*)

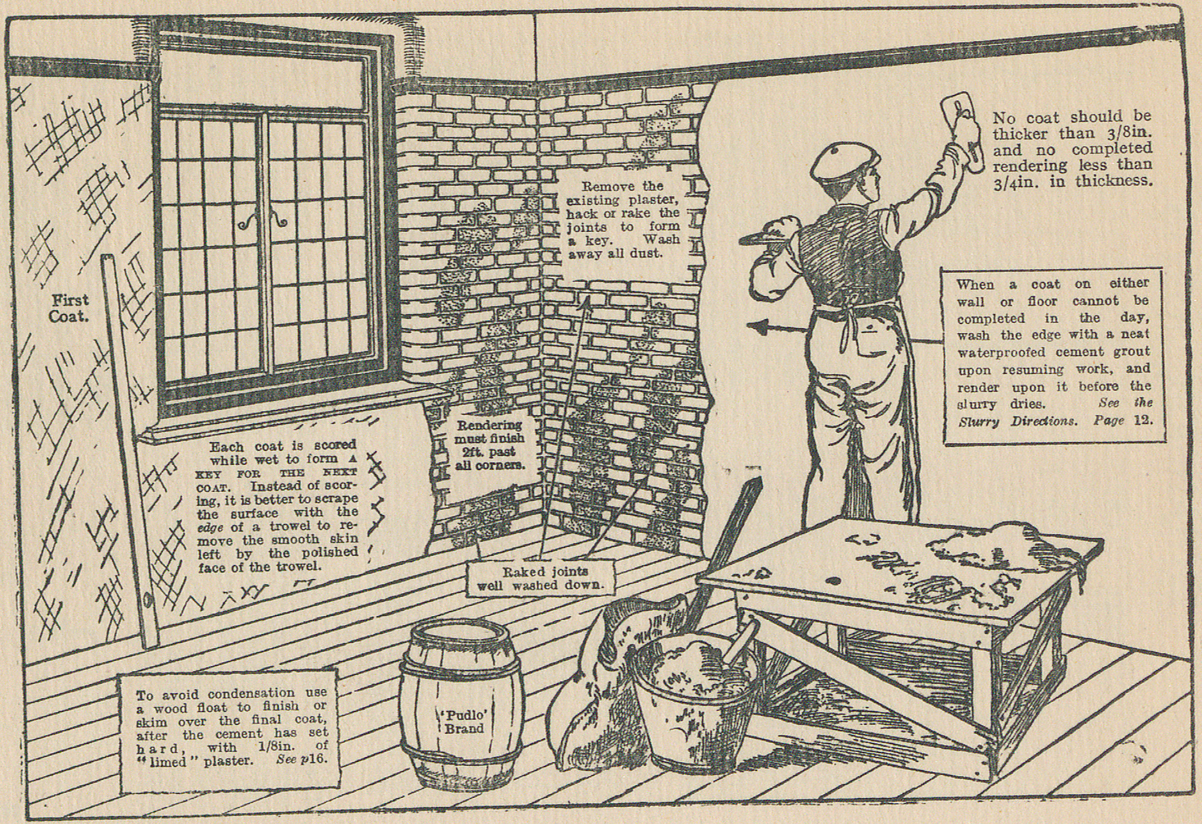
If the existing plaster is only ¾-in. thick, finish the waterproofed cement flush with it, i.e., ¾-in. thick (in 2 coats) and add 5% of the waterproofer instead of 3%. (*⅞-lb. per yd. sup.*)

For walls built on waterlogged or clay land, render 1in. thick (in 3 coats) :— 2 parts of sand to 1 of cement with 5% of 'Pudlo' Brand Waterproofing Powder

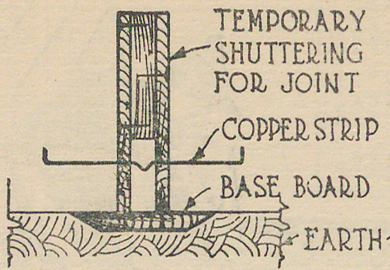
The waterproofed rendering to be taken at least two feet above the level to which dampness shows, to exclude any moisture that may rise by capillary attraction.

To prevent condensation—see notes on page 16.

This sketch shows how the interior surfaces of solid external walls are plastered with waterproofed cement to exclude the weather, when it is not desirable to stucco or roughcast upon the outside. Many of the points illustrated are applicable to all waterproofed cement plastering.

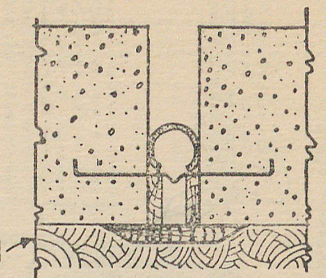


EXPANSION JOINTS



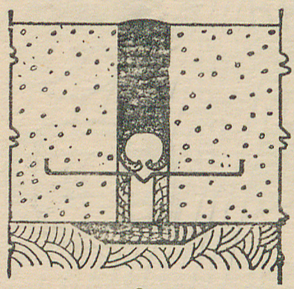
A

The shuttering that forms the expansion joint between adjacent slabs, is here shown with the copper strip in place, ready for the deposition of the waterproofed concrete.



B

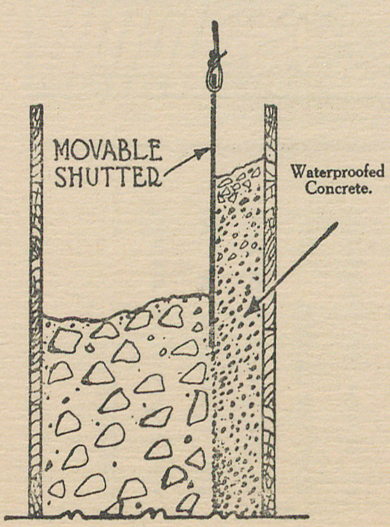
The upper part of the shuttering, having also served as a screed for the concrete, is removed. A piece of thick hair felt is rolled up, and placed in position as shown.



C

The finished joint, filled in with melted asphalte which has a high bitumen content, so that it yields readily with expansion and contraction. The pad of felt keeps the corrugated copper strip free to adjust itself to slight movements. The concrete sides to the joint must be carefully dried and " fatted " with bitumen to ensure adhesion of the asphalte.

The construction illustrated is of an expansion joint formed in the waterproofed concrete bottom of a reservoir. It is equally applicable to flat roof constructions. In such cases the joints are usually placed over the centres of supporting steel beams, and the base board is not necessary. The slabs are made stronger than if they were continuous over the intermediate supports, as shown in type A on page 25.



D

THICK CONCRETE WALLS

When thick concrete walls are formed, it is wasteful to waterproof the whole mass. In such cases, it is sufficient to form the inner 4in. with waterproofed concrete, held in place by a movable vertical shutter, which is lifted immediately the non-waterproofed concrete is deposited upon the other side and tamped down. The removal of this shutter permits the waterproofed and non-waterproofed concretes to coalesce and form a homogeneous wall. The backing of non-waterproofed concrete need only be of such proportions as are required to provide sufficient strength, which allows of considerable economy.

Weatherproof Walls.

The principle of cavity wall construction is attractive in theory, but those who have to supervise the building of such hollow walls, fully realise the many drawbacks of this device to exclude the weather. The disadvantages are most apparent in small buildings, where the external walls consist of two half-brick leaves, with a 2-in. cavity between them. The outer leaf is simply a veneer and contributes practically nothing to the strength of the inner half-brick wall, which has to bear all the weight of the upper floors, etc. A cavity wall 11ins. thick is therefore much weaker than a 9in. solid wall having the same amount of brickwork.

The labour of building the wall in two separate halves to form the cavity, and the cost of the wall ties that are necessary to anchor the outer walls to the inner leaf, make the cavity wall a more expensive construction. This expense is made greater by the necessity for providing battens to reduce the amount of mortar, etc., that falls down the cavity. Unfortunately, however, even with the greatest care and strictest supervision, mortar does drop into the cavity, lodging upon the wall ties, and thus providing bridges by which dampness crosses the cavity from the outer leaf. It is often possible to stand inside a building with exterior walls of cavity construction, and trace the positions of the wall ties by the spots of dampness that show inside. The mortar droppings will often fill up the bottom of the cavity for a foot or more. The removal of this accumulation of mortar is very expensive, and if neglected, will most certainly give rise to dampness inside the building, as the moisture is conducted to the inner leaf of the wall above the level of the horizontal dampcourse.

Unless expensive lead aprons are provided over door and window openings, and slate dampcourses are used to stop off the cavities at the reveals of such openings, the dampness will get through at these points. Cavity walls provide haunts for vermin, which often get inside during the construction of the building, before the gratings are fixed to the fresh air inlets.

A solid wall has the greatest strength for a given amount of brickwork, and is constructed at a much less cost than a cavity wall. When the outer face of the wall is rendered or roughcast in waterproofed cement mortar, no moisture can pass into the substance of the wall. A dry solid wall is much more effective in keeping a house warm in winter than a cavity wall with its outer parts saturated by rain, and with a current of air circulating throughout the cavity.

When it is desired to face a solid wall with bricks or stone, the waterproofing is effected by means of waterproofed mortar undercoats to the interior plastering. The cost is very little more than ordinary plastering, because the same labour of application would have to be incurred with the ordinary lime mortar undercoats, and the quick setting of the waterproofed cement mortar, enables the work to be carried on without delay.

This treatment also expedites the drying out of the house after construction, which is a substantial benefit. External walls are usually the thickest and contain the most moisture of construction; *as this moisture cannot pass through the waterproofed cement rendering to the inside of the house, it must dry outwards.* The interior walls soon become dry, because they are subject, on both sides, to the warmth of the house. The finishing coats of all interior plastering should be of absorptive lime plaster as described on page 16 under the heading:—"To prevent Condensation."

Three Methods of Waterproofing Concrete Blocks.

1. THIN FACINGS DURING MANUFACTURE. When a ¼-in. cement facing is treated with 'Pudlo' brand waterproofer it is sufficient to make the most porous block weather-tight. Such a thin surfacing must be applied while the block is being made—that is, before the concrete sets.

Use—3 parts coarse, washed sand. 1 part of Portland Cement.

3lbs. of 'Pudlo' brand powder to every 100lbs. of cement.

This facing must be mixed "wet" and not "semi-dry" as the latter mixture is not satisfactory for thin facings. Machines are now made with attachments for applying a ¼-in. facing.

2. FOR ROCK-FACED AND ORNAMENTAL DRESSINGS. A waterproofed facing of not less than 1in. in thickness is used. The facing may be composed of: 7 parts of ¼-in. granite chips, flints or pebbles.
3 parts of coarse, washed sand.
4 parts of Portland Cement.
} This is 2½ to 1.

5lbs. of 'Pudlo' brand powder to every 100lbs. of cement.

Mix this as wet as practicable, but do not make it so wet that it will stick to the mould or machine. When facings are mixed "semi-dry" they are difficult to waterproof.

3. POROUS CONCRETE BLOCKS which were not waterproofed when manufactured may be plastered (rendered) upon the outside, or the inside of the building, with cement mortar mixed with the waterproofing powder. Exterior renderings are preferable because they keep the substance of the walls both airtight and dry and so a warmer building is given. See the notes on condensation on p. 16 and the specifications on p. 26.

RESULTS OF TESTS

Made at the Engineering Laboratories, University College, Cork.

PERCOLATION through Cement Concrete.

The specimens tested were as follows :—

Three 1½in. Slabs with ' Pudlo ' Brand Waterproofer.
Three 1½in. Slabs without being waterproofed.

The Slabs were made as follows :—

4 parts stone from ¾in. to ⅛in.	=	44 lbs.
2 parts standard sand	=	22 lbs.
1 part Portland Cement	=	11 lbs.

When ' Pudlo ' Brand Powder was included :—

5lbs. of the Powder to 100 lbs. cement = 9 oz.

The 12% of water used was in terms of weight of dry materials.

The age was 28 days, as follows :—3 days in moulds.
4 ,, ,, water.
21 ,, ,, air (dry).

Area in square inches.	Head of water.	Slabs without the Waterproofing Powder. Weight of water which passed in 15 mins.	Slabs with ' Pudlo ' Brand Water-proofing powder.
42¼	8⅓ft.	6 oz.	No water passed, and the bottom of slab was dry after 6 hours.
42¼	8⅓ft.	1 lb.	
42¼	8⅓ft.	6¼oz.	

(Signed) H. C. JOHNSON, D. Sc.,
February 16th, 1914.

OBSERVATIONS.

This is one of four very important tests, all of which prove that ' Pudlo ' Brand Waterproofing Powder makes cement absolutely waterproof. Of the other three tests, one was made in Canada by the Corporation of Winnipeg, one in Japan by the Japanese Imperial Government, and the other at the Government Laboratory of the Military Engineers, Madrid, Spain.

RESULTS OF TESTS

By Henry Faija & Co. (D. B. Butler, Assoc. Inst. C.E., F.C.S.,) on a sample of 'Pudlo' Brand Waterproofing Powder.

TENSILE STRAIN upon Cement Mortar.

The figures give the average strength of 5 briquettes in each test.

SEVEN DAYS' TEST.

Description.	Average Tensile strength per square inch.
1 part cement 3 parts standard sand gauged with 8% of water	**360 lbs.**
1 part cement 3 parts standard sand 2 parts 'Pudlo' Brand Powder added to 100 parts cement gauged with 8·16% of water	**368 lbs.**

FOURTEEN DAYS' TEST.

Description.	Average Tensile strength per square inch.
1 part cement 3 parts standard sand gauged with 8% of water	**421 lbs.**
1 part cement 3 parts standard sand 2 parts 'Pudlo' Brand Powder added to 100 parts cement gauged with 8·16% of water	**425 lbs.**

The briquettes were placed in water 24 hours after gauging.

(Signed) HENRY FAIJA & CO., London, 9th November, 1909.

OBSERVATIONS.

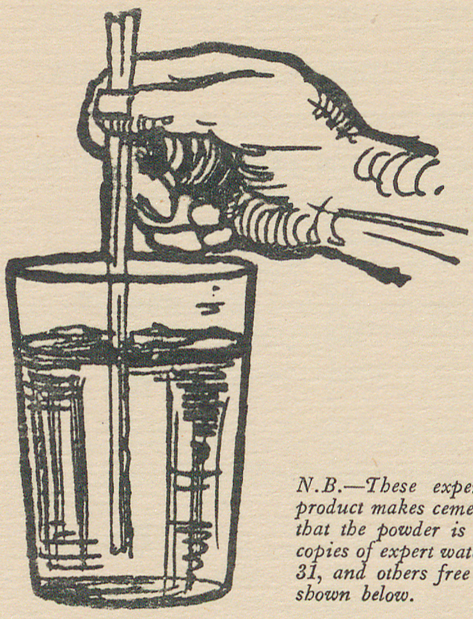
Every test has proved that cement mortars and concretes are not affected adversely by the addition of 'Pudlo' Brand Waterproofing Powder—even after a prolonged period.

The increase in strength is not sufficient to afford any material advantage, but it is important proof that the waterproofing of cement by the addition of 'Pudlo' Brand powder is perfectly safe, and likely to be advantageous to its strength rather than otherwise.

SIMPLE TESTS

The following test shows the remarkable action of 'Pudlo' brand powder when in contact with water.

Test a sample of the powder in this way yourself. If we have omitted to send you a sample, please write and ask us for one.



Sprinkle a dessert spoonful of the waterproofing powder into a tumbler half full of water. Push a spill of paper or your finger to the bottom of the glass and withdraw it. Either will be quite dry when taken out. Even if you use a match to stir the water you will be able to ignite the match when it is withdrawn.

Then place the hand on the top of the glass and shake well. The powder still floats.

N.B.—These experiments do not prove that our product makes cement waterproof. They only show that the powder is antagonistic to water. See the copies of expert waterproofing tests on pages 30 and 31, and others free on request, also experiment as shown below.

The following percolation tests are simply done, and the results are very convincing.

Make two pats of cement mortar, mixed, 3 parts of washed sand to 1 part of cement. Use 5 ounces of 'Pudlo' Brand cement waterproofing powder to 100 ounces of cement, the waterproofer being mixed in one pat only. Do not mix the mortar too wet, about 12% of water is sufficient.

THE TWO CEMENT PATS.

Put the mortar into two greased boxes, then press into the soft mortar in each of them, a jar or saucer to make an indentation large enough to hold water. Keep these pats in a cool place covering them with a wet-cloth. After three days take off the boxes. Keep the finished specimens in water for four days, and then let them stand to dry for 21 days. Then fill with water, when you will find the specimen which has been water-proofed with the 'Pudlo' Brand powder is non-absorbent, and water will be retained in it until it has evaporated. Next soak them for a few hours and then break each specimen in two. The interior substance of the water-proofed cement will be quite dry while the ordinary cement will be damp right through. Note that the waterproofed cement retains its bright colour after immersion, but the non-waterproofed cement quickly darkens owing to the absorption of water.

Builders', Estate Agents' and other Testimonies

Selected from a vast number of letters received from all parts of the world.

W. H. THOMPSON, Esq., Builder, Wood St., Higham Ferrers, Jan. 9th, 1915.

He was asked if he could make a large water tank sound, which was leaking all round. It had been cement rendered ⅜" thick. First he had the cement inside hacked to form a key. Then mixed 3 parts of washed sand, 1 part of cement, with 'Pudlo' Brand Waterproofing Powder, and put on ⅜" thick with the angles rounded. This made a good, sound job.

Another case was a cellar floor. In a wet time water oozed up out of the floor and flooded the cellar 9in. deep in water. The brick floor was taken up, excavated to the depth of 4", and replaced with 4" of cement concrete. Then a layer 1" thick, 2 washed sand, 1 cement, with some 'Pudlo' Brand Waterproofer, and the wall rendered 2' high. It is now as dry as possible.

He writes that he has done several jobs to damp walls with great success.

CHOAT & SON, Chelmsford (Established 1840), 25th July, 1911.

Write that they have used 'Pudlo' Brand Cement Waterproofer to keep out water in a large cellar which was always damp, and in rainy or wet weather flooded. They used some in a stoke hole near a river and below head of water. They also used it for the flat roofs of two houses—with good results in all cases.

F. HAMLETT, Esq., Estate Agent, Plaistow, May 1st, 1910.

Writes that after having tried all other methods known to him for preventing water entering a cellar, with failure as a result in every case, by cementing the walls with a mixture of 95% of cement and 5% of 'Pudlo' Brand Waterproofer a complete cure was effected.

F. & H. F. HIGGS, LTD., Builders & Contractors, Herne Hill, Oct. 3rd, 1922.

They were anxious to extend a basement by making use of some old vaults at 43, Leicester Square, London. There was often water standing on the floor where it had dripped from the old vaulting. Openings were cut in the basement wall, steel joists inserted with pavement lights over, and the vaults rendered with cement, sand and 'PUDLO' Brand Waterproofing Powder.

The whole of the vaults were made perfectly dry and have been in occupation for the last six years without a complaint of any sort.

HY. DUKE & SON, F.S.I., Land Agents, Dorchester, Feb. 1st, 1915.

Their Surveyor, H. A. Batchelor, Esq., writes (after receiving one of our circulars), that a reminder was not necessary, for 'Pudlo' Brand Powder is always in mind when he wants a waterproof job. It has proved itself excellent.

He had very difficult work in hand to keep water out of a furnace hole for heating glass houses. The water was some two or three feet all round. To overcome this the furnace had been set in a galvanised tank. This becoming rusted through, let the water in and flooded the fire.

He took the whole out, put a concrete bed in, built the walls in cement, and rendered the whole inside with cement. Both the concrete and the rendering were treated with 'Pudlo' Brand Waterproofer.

It is now absolutely bone-dry—a perfect success, although there are at least two feet of water all round. He writes after the work had been done two seasons.

WM. MACINTOSH, BURN & CO., Engineers, Calcutta, India, Oct., 1914.

Write that they used 'Pudlo' Brand Powder for waterproofing the cement lining of a large underground vault for one of the Calcutta Banks, with great success.

The case was an extremely irksome one, as being near the river bank, they had to contend with a five-feet tide. Ordinary cement was a failure, but the admixture of the Powder made a complete success of the vault.

ADVANTAGES THE APPEARANCE of cement work, when waterproofed with 'PUDLO' Brand Powder, is markedly brighter and more stonelike than ordinary cement work. When wetted, the difference is intensified; the waterproofed cement remains bright, but the non-waterproofed cement, being porous, sucks in the water and darkens in colour. If the water is dirty, the dirt is drawn in with it, and remains to permanently stain the surface.

For these reasons 'PUDLO' Brand waterproofer is used for bath linings, stucco, and by the makers of artificial stone. They find it also minimises the risk of hair cracks and the staining of white cement, which must be waterproofed if its full decorative value is to be maintained.—See pages 4, 29 and 37.

THE SETTING QUALITIES of cement are not affected. Cement sets hard when a large percentage of the waterproofing powder is mixed with it. Note that 5% is the largest amount needed in any cement plaster or concrete. If more of the waterproofing powder is used it is wasted.

THE STRENGTH of cement, both in tension and compression, is slightly increased. This is proved by Faija's test printed on page 31, and by other tests made by Messrs. Kirkaldy, Cork University, etc.

SAFE. Cement work waterproofed with PUDLO' Brand Powder never deteriorates *and never loses its waterproof qualities.* Messrs. Faija (the eminent English cement experts) have analysed and tested our product. They wrote:—"*So far as we can see there is nothing in it which would be likely to react detrimentally on the cement after prolonged periods.*" TESTING NO. 9337. ANALYSIS NO. 9097. This is borne out by the tests made by Messrs. David Kirkaldy & Son at regular intervals over a period of two years. It was proved that cement mortar, waterproofed with 'PUDLO' Brand Powder increases consistently in strength as it gets older.

ECONOMICAL All ordinary cement plastering is porous, even if neat cement or a mixture of one part of sand and one part of cement are used.

With the addition of 'Pudlo' Brand waterproofing powder the plastering will be perfectly waterproof with one part of good cement mixed with three parts of sand for ordinary conditions, and with two parts of sand for extreme conditions.

Cement mortar when mixed with 'PUDLO' Brand Powder has a plastic, manipulative property that the plasterer is otherwise tempted to obtain by an extravagant proportion of cement. Such excess of cement is one of the chief causes of hair cracks and crazings.

Expansion of cement concrete or renderings is minimised by the addition of 'PUDLO' Brand waterproofer. Ordinary cement mixtures expand considerably by the absorption of water. The waterproofing of the cement prevents this, and so removes a frequent cause of cracking. See page 5.

Waterproofed cement works fat, even with three parts of sand. This plasticity is a great aid to good workmanship. Whatever can be done with ordinary cement can be done, and done better, when the waterproofing powder is added.

SIMPLICITY. The simplicity of using ' PUDLO ' Brand waterproofing powder is undoubtedly a great factor in the freedom from failure. We find that practical men appreciate the fact that a powder is the simplest and safest method of impregnating cement. We have never known it to fail when used according to our simple directions.

NOTHING INJURIOUS TO HEALTH is used in the manufacture of ' PUDLO ' Brand waterproofer. It is used for cementing reservoirs and cisterns which contain drinking water, and also for storage bins which contain delicate edibles.

The Institute of Hygiene have awarded their certificate after testing the powder analytically, bacteriologically and practically.

They found that it not only made Cement quite impervious to water but the report reads :—" samples submitted contained nothing prejudicial to health and were free from any deteriorating ingredients."

NO SPECIAL KNOWLEDGE is required to use the waterproofer. The use of Portland Cement occurs in the every-day work of all builders, so that local labour and local materials are used, with a consequent saving of the expense and delay which occur when this kind of work is done by specialist workmen, with special materials and plant, which have to be brought from a distance.

UNDERGROUND STRUCTURES such as basements, cellars, stoke-holes, garage pits, and man-holes, even when subject to the most violent floods, are made bone dry with cement which has been waterproofed with ' PUDLO ' Brand Powder. There is no material so suitable as waterproofed cement for structural waterproofing, because it also has great strength and power of adhesion. Waterproofed concrete and cement renderings are part of the structure, and add to its strength. The economy that is thus made possible in the waterproofing of an existing basement is clearly shown by the illustrations on page 7.

The many hundreds of basements that have been treated successfully, prove the soundness of the methods described in this book, and in many cases the work has been accomplished with ' PUDLO ' Brand waterproofer after all former attempts to cure had failed.

WATERTIGHT RECEPTACLES are economically constructed and repaired with waterproofed cement. Tanks and reservoirs for drinking water and for many commercial uses, including the 18-million gallons reservoir at Winnipeg, have been rendered or concreted in cement so treated. Also swimming baths in important buildings like the Midland Railway Company's Adelphi Hotel at Liverpool (Architect, the late R. Frank Atkinson, Esq., F.R.I.B.A.) and many open air swimming pools.

DAMP WALLS often remain untreated because it is thought that the expense will be heavy. A waterproofed cement rendering will permanently exclude all traces of dampness, and the cost is little more than that of ordinary cement.

DEFECTIVE DAMPCOURSES are a common source of trouble, and the only way to cure, apart from cutting out for and inserting a new horizontal damp-proof course, is to strip off the plaster on the inside and give the wall a coating of waterproofed cement mortar. See Specification on page 26. The room becomes dry as soon as the cement has set hard ; no other method is so quick in effecting a cure. When a horizontal dampcourse is inserted, a long time elapses before the moisture left in the wall is drawn out by evaporation. Also it is expensive and there is danger of settlement cracks.

It is advisable to give the waterproofed cement a coat of absorptive limed plaster, because dense cement surfaces are more susceptible to condensation than porous plaster surfaces. If a cement finish is desired, it is better to finish with a wood trowel (float) as condensation is less frequent upon a rough surface. (See page 16).

INTERIOR RENDERINGS are applied with equal success to walls made damp by the weather, or by earth banked up on the outside. This treatment can be safely recommended when an adjoining owner's land cannot be disturbed for the purpose of applying an exterior treatment, or when it is not desired to alter the appearance of brick or stonework facings to walls.

Architects have shown the greatest interest in this interior treatment for overcoming dampness in walls, faced with beautiful brickwork or stonework, which would be spoiled by any exterior application. The charm of many ancient buildings consists chiefly in their weathered exterior surfaces, and as these buildings are rarely provided with effective horizontal damp-proof courses, the interior rendering of waterproofed cement is the surest and most economical remedy.

The advantages of an exterior treatment must not be overlooked. An outside rendering keeps the substance of the wall dry, and dry walls help to make a house warm in winter and cool in summer. *It is worse than useless to apply an outside rendering to a wall that has a defective damp-proof course. Such a treatment shuts in the moisture that rises by capillary attraction from the wet foundations, and as it can then only escape from the inner face of the wall, the dampness is accentuated.* The proper remedy is an INSIDE rendering—see specification on page 26.

ROUGHCASTING, because of its uneven surface, holds water which driving rains force into the wall. Pebble or stone dashing has an additional disadvantage, because of the ducts made for the moisture when the stones become loose. The latter defect is provided against by placing a larger amount of waterproofing powder in the cement of the first coat. Sand dash and plain stucco are treated with a smaller percentage of the waterproofer in both coats.

PARAPET WALLS AND CHIMNEY STACKS are exposed to the weather on all sides. The rain drives into the porous brick or stonework, and soaks down until it shows in the rooms below. Wet chimneys are cold and cause down-draughts, but if the stack is built and pargetted in cement that is waterproofed with 'PUDLO' Brand Powder, it is kept dry and warm ; the flues do not then hold the smoke. There is no need for costly sheet lead dampcourses to stacks or parapets. Build them with waterproofed cement mortar—every joint is then a dampcourse that prevents the soakage of moisture through even the most porous brick or stonework.

POINTING BRICKWORK AND STONEWORK. A small percentage of 'PUDLO' Brand waterproofer makes the cement pointing mortar work fat and smooth. This fatness is a most desirable quality in pointing mortar because it facilitates the work and gives a better result.

GLAZED BRICKS AND TILES should be set and pointed with waterproofed cement. This prevents the percolation of water into the porous "biscuit" of the tiles or bricks, and so obviates the staining which occurs when water and dirt are drawn through the joints, and then behind the glaze.

EFFLORESCENCE (or Salting) is a frequent defect in ordinary cement work. It occurs when chemical salts are present in the substance of the wall. Dampness must also be present, although in the case of a new wall, this may be the moisture of construction. These salts are dissolved by the moisture and the solution then travels to the surface. The moisture evaporates and leaves the salts in the form of crystals. Efflorescence cannot form upon the surface of, nor pass through cement work that is waterproofed with 'PUDLO' Brand Powder. For the treatment of existing walls that are damp and have developed efflorescence, see page 11.

ARTIFICIAL STONE makers use 'PUDLO' Brand waterproofing powder to give a better appearance to their work. The texture is then more akin to stone and the arrises are more pronounced. The rain is not absorbed into the stonework, but is repelled. A non-waterproofed artificial stone soon becomes rain sodden and dirty ; it is very subject to hair cracks and the dirt that collects in these cracks makes the disfigurement more pronounced. The freedom from hair cracking that distinguishes waterproofed cement surfaces is explained on page 5. See also the specification for concrete blocks on page 28.

WELLS. Ingress of water to a well should only be permitted at the level of the water-bearing strata, yet the loosely constructed and porous sides of most wells allow free percolation of water that is contaminated by surface and other drainage.

A simple remedy for this dangerous condition is to apply to the inside of existing wells a rendering 1 inch thick of sand and cement which has been waterproofed by the addition of 'PUDLO' Brand Powder. In addition to excluding all foul water, the smooth surface of the waterproofed rendering is sanitary. Brickwork and stonework allow crevices for fungoid and other growths which are often, in themselves, sources of infection.

This treatment with waterproofed cement dispenses with the use of clay puddle which shrinks in hot weather allowing impurities to pour through the cracks thus formed. (See proportions on page 8).

JOINTING PATCHES. Plasterers find that when the cement undercoats are waterproofed with 'PUDLO' Brand Powder, there is not the marked difference in colour that otherwise shows up those parts of the finishing coat, applied on different days. This variation in colour is due to the difference in suction which occurs when one part of an *ordinary* cement undercoat is older and harder than another part. The waterproofed cement does not absorb the moisture from the plaster, or cement finishing coat. It is not necessary to damp the cement undercoat, and so labour is saved, and the appearance greatly improved.

CEMENT FLOORS in DAIRIES, WASH-HOUSES, ABATTOIRS, URINALS, ETC., when waterproofed with 'PUDLO' Brand Powder are impervious to rising dampness, and also to water and to the liquids which are usual in these buildings. Such liquids cannot soak into the cement. As soon as the surplus moisture is removed, the floors become bone dry. A non-porous floor is more sanitary and wears longer than a porous floor. (See specifications on page 23.)

CONCRETE UNDER WOOD FLOORS. Ventilation and dryness are essential to the preservation of timber. The many well ventilated floors which decay, prove the necessity of dryness. This is easily attained by lining the space under the floor with cement mortar, waterproofed with 'PUDLO' Brand Powder. See specifications on page 23. A remedy for damp and decayed wood floors can only be permanent when the causes of the trouble are removed.

JOINTLESS COMPOSITION FLOORS must be protected from rising dampness. Many of the well known firms who specialise in this type of flooring recommend that the surfaces of all concrete floors laid upon the ground, be screeded with waterproofed cement before their composition finish is applied. (See page 23).

EARTH BANKED WALLS. When the work is new, these should be rendered on the outside, but when an existing wall is already damp, an immediate and permanent cure is effected by rendering with waterproofed cement upon the inside. This keeps back the dampness, just as surely as a sheet of glass excludes the rain. It takes up no more space than the ordinary plastering, and costs but very little extra. See specification No. 3 on page 26.

VAULTS AND BRIDGES. Old arched vaults built under pavements are often structurally sound, but nearly always damp. Re-building schemes frequently leave these vaults undisturbed, and they make valuable dry storage places if rendered on the inside with waterproofed cement mortar.

A leaking bridge is made permanently watertight with a rendering of waterproofed cement applied to the under-surface of the arch. The waterproofing of the concrete decking to a steel girder bridge prevents the nuisance of water dripping on to the road.

DRY AREAS (or double walls with cavities) are not necessary where earth is banked on to an outer wall. A permanently dry and healthy interior is easily obtained when the walls are rendered either outside or inside the building, with washed sand, cement and 'PUDLO' Brand waterproofer. (See Specification 3, page 26).

CONCRETE ROOFS in all parts of the world have been constructed with cement waterproofed with 'PUDLO' Brand Powder. When a roof is used as a promenade or for the storage of bulky articles, there is no danger of wear or damage to the surface.

DOMES have been similarly formed, notable examples being the domes to the Town Hall at Chadderton, and the Chorlton-cum-Hardy Free Library.

GUARANTEE

The tests on pages 30 and 31 will convince the most sceptical that our product really waterproofs Cement Mortar and Concrete without detracting from their strength.

Every ounce of 'Pudlo' Brand waterproofing powder is consistently made. Automatic machinery is employed, wherever it is practicable, to eliminate the human element of carelessness or incompetence.

WE THEREFORE GUARANTEE that every consignment of 'Pudlo' Brand powder possesses the same analytical purity and waterproofing power as that used for the tests described on pages 30 and 31, and for the other various tests by independent English experts; also by the British, Japanese, Spanish, Dutch, and other Governments. Copies of Tests free on request.

Many builders have successfully used 'Pudlo' Brand Waterproofer for most difficult work and have thus convinced themselves that the powder fulfils all the claims made for it.

When Architects and Engineers insist upon guaranteed work, we can refer them to experienced firms, in various parts of Great Britain, who will give a guarantee. We invite applications from builders who wish to be included in our list of recommended contractors.

There is no exceptional skill required to execute waterproof work with the aid of 'Pudlo' Brand powder. Our simple instructions are easily followed by all artisans who use cement. We cannot, however, be held responsible for poor workmanship, inferior materials, for structural defects and cracks, or for damage of any kind caused by wrong usage, or work carried out in unfavourable weather.

WHY IT IS A POWDER

'PUDLO' Brand waterproofer could be made as a liquid or a paste which would require to be added to the gauging water before admixture with the cement and sand or other aggregate, but after much consideration the dry powder was decided upon for the following reasons :—

1.—A powder is the most concentrated form possible for a cement waterproofer, and it is not subject to loss by evaporation or spoliation, even if kept for many years.

2.—It is mixed with the cement as easily as cement is mixed with sand, and the distribution is perfectly even throughout the concrete or mortar. When a *paste or liquid* is added to the gauging water it must be constantly stirred to keep the solution of even strength.

3.—'PUDLO' Brand waterproofing powder is always definitely proportioned *to the cement.* If a *paste or liquid* were added to the gauging water, the proportion of the waterproofer to the cement would vary according to the amount of water used. Watch the mixing, by hand, of a batch of cement mortar or concrete; although the dry cement and aggregate are carefully measured, the amount of water is usually decided in a very haphazard way. Even if the amount of water is strictly controlled, it must be varied according to whether there is much, or little sand and aggregate, and how they are graded. The Concrete Year Book, 1927, of which Dr. Oscar Faber is joint Editor states that "*the amount of water required to produce concrete of a given plasticity is a function of the grading and the maximum size of the aggregates.*" It should be added that

the dryness of the aggregates will also influence the amount of water. If sand or gravel have been wetted by rain, the amount of gauging water required to make the concrete will be less than if the aggregates were dry. Conditions of use, *i.e.*, whether hand or machine mixed; hand-placed or mechanically conveyed, and the actual constructional details of the work, will all call for varying adjustments of the water content—and make it practically impossible to ensure any definite proportion between the cement and the waterproofer that has been added to the gauging water.

4.—A *liquid or paste* is liable to loss of moisture when once a package has been opened or has sustained slight damage. In addition, heavy freight charges are incurred, owing to their greater weight as compared with a dry powder. It is indeed absurd to pay carriage charges for the transport of water when this water can be obtained at an infinitesimal fraction of the cost, upon the site of the work.

SAFEGUARDS AGAINST SUBSTITUTION.

The purchaser of 'PUDLO' Brand Waterproofer is protected from fraud by substitution, if he always insists upon delivery of the material in our factory packages. The smallest quantity sold is 7lbs., packed in a tin which always bears our distinctive yellow label with green bands. With the exception of these tins, the material is sent in our branded wooden boxes made by our own box-making machinery at the King's Lynn Factory. These boxes are machine-tied with wire, which is a very effective safeguard against tampering, and the boxes are paper lined. The waterproofing powder is in a branded cotton bag, which is tied and further secured by a lead seal bearing our Brand.

PRICE LIST.

The Prices are Strictly Maintained.

	Price per lb.	How Packed.	Cost of Packages.
	s. d.		s. d.
1 ton lots or over -	11	Boxes	3 0 per cwt.
½ " " " " -	1 0	"	"
5 cwt. " " -	1 1	"	"
1 " " " " -	1 2	"	"
½ " " " " -	1 4	"	1 6 each
28 lb. - - -	47 6 per package	"	FREE
7 lb. tins - - -	12 6 "	....Tins	FREE

Boxes and tins are not returnable.

All Prices include free delivery to any Railway Station in the U.K. and Irish Free State and are nett.

SPECIAL PRICES FOR EXPORT.

'Pudlo' Brand Cement Waterproofing Powder is retailed under a licence which regulates the price. Any person selling it above or below the authorised prices is liable to an action at law, as the Agents' profit is made by buying the larger quantities and retailing as above.

REGISTERED **'PUDLO'** TRADE MARK

BRAND
CEMENT WATERPROOFER

HAS BEEN SOLD IN THE BRITISH ISLES TO

THE BRITISH GOVERNMENT:

THE ADMIRALTY. THE AIR MINISTRY. THE WAR OFFICE
H.M. OFFICE OF WORKS. THE INDIA OFFICE. H.M. GENERAL POST OFFICE.
THE CROWN AGENTS for the COLONIES.

DUKE OF BEAUFORT
DUKE OF BUCCLEUCH
DUKE OF DEVONSHIRE
DUKE OF HAMILTON
DUKE OF MARLBOROUGH
DUKE OF NEWCASTLE
VISCOUNT FEILDING
THE MARQUESS OF AILESBURY
THE MARQUESS OF ANGLESEY
THE MARQUESS OF BATH
THE MARQUESS OF CREWE
EARL OF ANCASTER
EARL OF CRAVEN
EARL OF DALKEITH
EARL OF DARNLEY
EARL OF DONOUGHMORE
EARL OF DUDLEY
EARL FITZWILLIAM
EARL FORTESCUE
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MAJOR THE LORD AILWYN, D.S.O., M.C.
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LORD ELCHO
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LORD HASTINGS
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THE MARQUESS OF EXETER
THE MARQUESS OF LONDONDERRY
THE MARQUESS OF SALISBURY
EARL OF HOME
EARL OF HOPETOUN
EARL OF LEICESTER
EARL OF LICHFIELD
EARL OF MACCLESFIELD
EARL OF NORMANTON
EARL OF PEMBROKE
EARL OF PORTSMOUTH
EARL OF RADNOR
EARL OF SEFTON
EARL SPENCER
LORD LECONFIELD
LORD LEVERHULME (The Late)
LORD LONSDALE
LORD LUCAS
LORD MERTHYR
LORD MONTAGUE OF BEAULIEU
LORD POWIS
LORD RAYLEIGH
LORD SACKVILLE
LORD SHAFTESBURY
LORD STRATHCONA (the late)
LORD VERNON
LORD VERULAM

Countries to which 'PUDLO' Brand Cement Waterproofer has been sent.

AFGHANISTAN
ALGERIA
ANGOLA
ANTIGUA
ARGENTINA
ASHANTI
ASSAM
AUSTRALIA
AZORES
BELGIUM
BELGIAN CONGO
BERMUDA
BOLIVIA
BORNEO
BRAZIL
BRITISH EAST AFRICA
BRITISH GUIANA
BURMA
CAMEROONS
CANADA
CANARY ISLANDS
CAPE COLONY
CEYLON
CHILI
CHINA
COCHIN CHINA
COLOMBIA
COSTA RICA
CUBA
DENMARK
DUTCH GUIANA
ECUADOR
EGYPT
FINLAND
FIJI
FORMOSA
FRANCE
FRENCH CONGO
FRENCH GUINEA
GOLD COAST
GREECE
GUATEMALA
HOLLAND
HUNGARY
INDIA
ITALY
JAPAN
JAVA
KOREA
LIBERIA
MADEIRA
MALAY STATES
MANCHURIA
MAURITIUS
MESOPOTAMIA
MEXICO
MOROCCO
NATAL
NEWFOUNDLAND
NEW GUINEA
NEW ZEALAND
NIGERIA
NORWAY
NYASALAND
PALESTINE
PANAMA
PARAGUAY
PATAGONIA
PERSIA
PERU
PHILIPPINES
PORTUGAL
PORTUGUESE EAST AFRICA
RHODESIA
RUSSIA
ST. KITTS
ST. LUCIA
ST. VINCENT
SENEGAMBIA
SIAM
SIBERIA
SICILY
SIERRA LEONE
SPAIN
SUMATRA
SWEDEN
SYRIA
TAHITI
TANGANYIKA
TIMOR
TRANSVAAL
TRINIDAD
TUNIS
TURKEY
UGANDA
URUGUAY
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And many thousands of Engineers, Architects, and other Private Users.

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